LEVEL II

(1)

Research Note 79-10

A069224

DEVELOPMENT OF UNIT TRAINING AND EVALUATION TECHNIQUES FOR COMBAT-READY HELICOPTER PILOTS:

Task 1.

Development of an Instruction Program for Individual and Unit Training with Combat-Ready Pilots

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Canyon Research Group, Inc.

Prepared for

U. S. Army
Research Institute for the Behavioral and Social Sciences

May 1979

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U. S. ARMY RESEARCH INSTITUTE

FOR THE BEHAVIORAL AND SOCIAL SCIENCES

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NOTICES

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: Research Note 79-10

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER: 9

4. TITLE (and Subtitle): 6 DEVELOPMENT OF UNIT TRAINING AND EVALUATION TECHNIQUES FOR COMBAT-READY HELICOPTER PILOTS: Task 1. Development of an Instruction Program for Individual and Unit Training with Combat-Ready Pilots.

5. TYPE OF REPORT & PERIOD COVERED: Research note, 21 Sep 77 - 20 Sep 78

6. PERFORMING ORG. REPORT NUMBER: FtR-05-78

7. AUTHOR(s): 10 George E. Long, Colin D. Ciley, Jr., Roik L. Hockenberger, Ethlyn A. Garlichs

8. CONTRACT OR GRANT NUMBER(s): 15 DAHC19-77-C-0059

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Canyon Research Group, Inc, 741 Lakefield Road, Suite B, Westlake Village, CA 91361

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 16 2Q263743A772

11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Army Aviation Center, Fort Rucker, AL 36360 12 85p.

12. REPORT DATE: 11 May 1979

13. NUMBER OF PAGES: 77

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): US Army Research Institute for the Behavioral and Social Sciences, 5001 Eisenhower Avenue, Alexandria, VA 22333

15. SECURITY CLASS. (of this report): UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

14 FTR-05-78

18 ARI 19 RN-79-10

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Unit Training and evaluation
Combat-readiness training
Training development
Training modules
Army training
Helicopter training
Combat aviation training
Aviation training
Key elements identification
Rotary wing training

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The attainment and maintenance of combat readiness must be a, if not the, primary responsibility of every field unit commander. To carry out that responsibility, commanders of units with combat missions need training and evaluation techniques that will train pilots who already know how to fly to accomplish the requirements of a specific mission in a battlefield environment as part of the combined arms team. In order to provide the required techniques and procedures noted above, it is first necessary to derive an effective and

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

391 185 LB over

20. continued

efficient approach to their development. That approach should result in the availability of techniques and procedures that will facilitate the attainment of the highest level of combat readiness in the largest number of operational units in the shortest amount of time. This report describes the reaearch effort directed at the derivation of an approach to the development of training and evaluation techniques and procedures for combat-readiness training that will meet the above noted requirements. It also describes the effort directed at the partial development of two training modules consistent with that approach.

Army Project Number
2Q263743A772

Aircrew Training
DAHC19-77-C-0059

Research Note 79-10

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May 1979

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ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the following individuals for their contributions to this research.

Dr. Donald Weitzman, US Army Research Institute for the Behavioral and Social Sciences (ARI), Alexandria, Virginia, who served as the Contracting Officer's Technical Representative (COTR) during this phase of the research.

Mr. Charles A. Gainer, Chief, ARI Fort Rucker Field Unit, and Dr. Martin Allnutt, ARI Exchange Scientist from the Army Personnel Research Establishment, Royal Aircraft Establishment, Farnborough, Hants, England, for their extensive reviews and many valuable suggestions for improvement to the report.

Dr. Robert T. Hennessy, Canyon Research Group, Inc., who served as Principal Investigator during the first few months of the research.

Mr. Bruce A. Smith, Canyon Research Group, Inc., who assisted in the conduct of the research and preparation of the report.

PREFACE

This report describes a part of the first year's research accomplished by Canyon Research Group, Inc. (Canyon) for the US Army Research Institute for the Behavioral and Social Sciences (ARI) on the "Development of Unit Training and Evaluation Techniques for Combat-Ready Helicopter Pilots." The research was accomplished as a part of ARI's Technical Area, "Human Performance in the Tactical Environment," under Contract No. DAHC19-77-C-0059. Dr. Donald Weitzman served as the Contracting Officer's Technical Representative (COTR) for this research.

This report covers the research accomplished under Task 1 (one of two tasks) of the contract Statement of Work (SOW). Task 1 called for the "Development of an Instruction Program for Individual and Unit Training with Combat-Ready Pilots." Task 2, "Assessment of ARTEP and ATM Training Objectives and Requirements for Maintaining Operational Readiness," was conducted concurrently and is reported in a companion report.

As originally planned, Task 1 was to initiate the development of a series of training modules based upon an approach proposed by Canyon. That approach specified a sequential selection of module development of *specific mission-related* operations/tasks to combat readiness. This, however, would have resulted in the requirement for a very large number of training modules. The anticipated time required for that development, as well as for training with such a large number of modules, was not consistent with the immediate and pressing needs for combat-readiness training. Hence, a more efficient and effective approach was deemed necessary.

Therefore, the program was reoriented. The primary objective of the research reported herein was the derivation of *an approach* to the development of training and evaluation techniques and procedures for combat-readiness training that would result in the greatest improvement in aviation unit combat readiness in the shortest possible time. The actual development of such techniques and procedures became a secondary objective.

1.0 INTRODUCTION

1.1 THE PROBLEM

The attainment and maintenance of combat readiness must be *a*, if not *the*, primary responsibility of every field unit commander. The execution of that responsibility will undoubtedly require some continuing program of individual and unit training or practice. However, the types of techniques and procedures that will be most effective in enabling aviation units to acquire and maintain the highest level of combat readiness possible, given the realities of an operational environment, have not been ascertained. Resources are limited; personnel are being replaced continuously; replacements arrive with various levels of skill, experience and training; and systems, tactics and the potential battlefield environments change frequently.

1.2 BACKGROUND

In the past, the Army attempted to insure combat readiness through mandatory training requirements for individual aviators. Aviators were required to obtain a specified number of flight hours, or to successfully perform designated maneuvers a specified number of times, within a certain time period. Recognizing the shortcomings of this approach, the Army recently changed its philosophy and placed the responsibility for both the amount and type of training on the unit commander. Commanders have been made responsible for determining the combat-readiness status of their units, and the training required to correct deficiencies; and, for developing and implementing the programs required to accomplish that training.

As an aid to the commanders in carrying out this responsibility, the Army has recently introduced the Army Training and Evaluation Program (ARTEP) and the Aircrew Training Manual (ATM) into the field. ARTEPs specify the missions which a given type unit must be able to perform, the standards for performance on those missions, and, in very general terms, how performance is to be evaluated. The ATMs define the flight tasks and performance standards for aviator qualification in specific aircraft. These documents, while still in the early stages of development and validation, are viewed by field commanders interviewed during the course of this research as very useful and effective aids. They assist in determining deficiencies in combat readiness and thereby, in a general way, the requirements for training. However, the ARTEPs and ATMs are not training programs.

1.3 THE SOLUTION

It seems apparent that unit commanders need "training and evaluation techniques and procedures" to assist them in achieving and maintaining a high level of combat readiness in their units. However, commanders of units with combat missions need training and evaluation techniques that will *train pilots who already know how to fly to accomplish the requirements of a specific mission in a battlefield environment as part of the combined arms team*. Those commanders need a number of *different* techniques

and procedures that can be selected for, or adapted to, the specific combat readiness deficiencies of their units at any specific time. They need techniques and procedures which can be used by the personnel assigned to their units with a minimum of outside or logistic support. Most importantly, they need techniques and procedures that will permit the attainment of combat-readiness proficiency on *all* required operations within a relatively short time period. A "relatively short time period" is one that is consistent with the need to be "always ready to meet the threat."

1.4 THE REQUIRED RESEARCH

In order to provide the required techniques and procedures noted above, it is first necessary to derive an effective and efficient approach to their development. That approach should result in the availability of techniques and procedures that will facilitate the *attainment of the highest level of combat readiness in the largest number of operational units in the shortest amount of time.*

This report describes the research effort directed at the derivation of an approach to the development of training and evaluation techniques and procedures for combat-readiness training that will meet the above noted requirements. It also describes the effort directed at the partial development of two training modules consistent with that approach.

2.0 RESEARCH PROCEDURES

2.1 RESEARCH OBJECTIVE

The primary objective of this research is the derivation of an approach to the development of combat-readiness training and evaluation techniques and procedures. The approach required is one that will result in maximum assistance to operational field units in attaining and maintaining a high level of combat readiness.

The development of techniques and procedures for training and for evaluation based on the above approach was a secondary objective.

2.2 RESEARCH APPROACH[a]

The research procedure followed in deriving the approach for combat readiness training program development was essentially the systems engineering approach as used in the development of hardware systems rather than the ISD approach normally used in the systematic development of training programs. The two approaches have much in common, but the latter is only applicable to the development of training programs once the specific task/operation for which training is required has been defined. In the present investigation, the major portion of the effort was directed at developments that were prerequisites to the definition of tasks/operations to be trained. Certain ISD procedures (as described later) were used in the efforts which were directed at the actual development of training techniques and procedures, once the tasks/operations for which training was required had been defined.

The systems engineering approach places major emphasis upon explicit definition of the objective(s) and requirements to be met by the *system*[b] that is to be developed. A major objective of such an effort is to insure that all essential requirements are included. However, it is equally important (and often more difficult) to be sure that non-essential requirements are excluded. Alternate solutions, or elements thereof, are then developed and evaluated in terms of the extent to which they satisfy *all, but only,* those explicitly defined objectives and requirements. The process is, of course, an iterative one with the initial requirements being refined and inconsistent or non-attainable requirements eliminated as development proceeds. This activity was considered very important in this research because of the likelihood of including features based solely on preconceived notions, from past experience, as to how training programs should be developed.

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[a]The term "research approach" refers to the approach followed in accomplishing the research as opposed to the "approach for training module development," to be derived through that research.

[b]*In this case, the "system" is "a set of training and evaluation techniques* and procedures required for combat-readiness training."

2.3 IMPLEMENTATION OF RESEARCH APPROACH

The definition of objective(s) and requirements was accomplished through several activities. Relevant documentation such as ARTEPs, ATMs, and Field Manuals were reviewed. Discussions were held with, and information obtained from operational personnel. Then, exploratory analysis and evaluation of various potential objectives and requirements was made to assess their utility and their impact on both development and training. This effort was aimed at defining a single objective to be achieved by combat-readiness training programs. Then, the specific capabilities to be provided by training and evaluation techniques, to make them most effective in improving combat readiness with the least expenditure of time and resources, were delineated and defined. This included the definition of those requirements related to acceptability and usability by operational units in the field, as well as those related to training effectiveness. While the major portion of this effort occurred at the beginning of the research program, the effort was continuous throughout the investigation. A substantial portion of the major modifications and changes found necessary involved the elimination of requirements determined to be not essential to achievement of the basic objective defined for training and evaluation techniques. An approach to the development of training techniques and procedures was then derived that would meet, as nearly as possible, the objective and those, but only those, requirements.

The derivation of the approach to the development of training and evaluation techniques and procedures was accomplished in part through the actual selection of critical operations/tasks and the partial development of preliminary training modules for those operations/tasks. In accomplishing these activities, different methods and procedures were tried. Some of these proved effective; some were effective following alteration or modification; others had to be discarded.

3.0 DEFINITION OF THE OBJECTIVE(S) AND THE REQUIREMENTS FOR COMBAT-READINESS TRAINING AND EVALUATION TECHNIQUES AND PROCEDURES

3.1 OBJECTIVE(S)

An essential requirement for the development of *any system* is a definition of the objective(s) of that system in terms that permit assessment of its achievement. Moreover, it must permit assessment within the framework of the anticipated development effort.

Since combat readiness is a relative concept, absolute criteria for its achievement would be difficult, if not impossible, to define objectively. It is also a very complex concept which, as noted earlier, encompasses a very wide range of activities. Moreover, it is dependent not only upon the level of skill or performance capability of a unit/crew, but also upon the battlefield environment and enemy capability at the time that skill or capability must be employed by a unit/crew.

The present effort anticipates the development and evaluation of different training and evaluation techniques, each of which must be assessed in terms of their capability to provide a partial solution to the achievement of combat readiness.

In view of these and related considerations, *the* objective of the required training and evaluation techniques was defined as follows:

> *The development of training and evaluation techniques and procedures that would provide for a significant improvement in the unit/crew performance of those operations or tasks*[c] *defined as follows:*
>
> a. *Those operations/tasks, including the conditions under which they must be performed, specified in the ARTEP as required for combat readiness.*
>
> b. *Those operations/tasks which responsible unit commanders designate as most critical to the accomplishment of their assigned combat-related mission.*
>
> c. *Those operations/tasks for which "adequate" training and evaluation techniques and procedures are not available as viewed by the responsible unit commanders.*

3.2 REQUIREMENTS

Analysis of the implication of this objective, along with an analysis of the operational conditions and environment relevant to its achievement, resulted in the isolation and definition of six essential supporting

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[c] The term "tasks" as used in this report refers to tasks as listed and/or described in the ATMs. The term "operations" is used to designate a number of tasks grouped together for training purposes.

and/or subordinate requirements. Training and evaluation techniques and procedures developed for combat-readiness training must meet *all, but only, these* requirements. These six requirements are defined below, with a brief discussion of the basis for their inclusion.

1. *Training and evaluation techniques and procedures must permit unit commanders to select different techniques and procedures at different times, to meet the training needs deemed critical at any specific time.* This requirement stems from the responsibility recently placed on unit commanders to determine their units' particular training needs and develop training programs to meet those needs. This responsibility engenders the requirement for the availability of modularized "techniques and procedures" from which a commander may select as deemed appropriate. Different units, even with the same mission, are not likely to have the same requirement for training.

2. *Training and evaluation techniques and procedures must provide for flexibility in usage to permit training emphasis on different elements of tasks, and to accommodate task element emphasis and different existing skill levels.* The training requirements of different units will change in different ways and at different rates. Therefore, a commander must not only be able to select techniques and procedures for the training of different operations and tasks, but he must be provided the flexibility to permit selective emphasis on different elements of an operation/task, and to train personnel possessing different levels of proficiency or skill prior to training.

3. *Training and evaluation techniques and procedures should have wide applicability to different combat readiness training needs.* This requirement relates to the need to minimize the number of techniques and procedures that must be developed and the time required to achieve significant improvements in combat readiness. Even if the development effort were restricted to *critical* mission-related operations/tasks, the number of techniques and procedures required would be very large *and constantly increasing* if they were required for *each operation/task for each combat mission*. Moreover, training through use of such techniques and procedures would be excessively time consuming and inefficient.

4. *Training and evaluation techniques and procedures should permit use, by the field unit concerned, with a minimum of logistic or "outside" support.* This requirement is closely related to the second. It means that units, as staffed, should be able to select and employ techniques and procedures, for both training *and evaluation* without the need for outside assistance and with resources available in the unit. It also implies that these techniques and procedures should permit field personnel to accomplish the required alterations for the flexibility in usage noted above. It would also be *highly desirable* to design both training and evaluation techniques to permit alteration or modification by field personnel as required to meet changes in systems, tactics or the battlefield environment.

5. *Training and evaluation techniques and procedures should provide training for those operations/tasks which are unique to the combat mission, or those operations/tasks in which the combat environment imposes unique conditions which directly affect performance on those operations/tasks.* This would include training in the performance of operations/tasks under conditions which, while not unique to combat, are imposed only because of the demands of combat (e.g., NOE at night). Units/crews to be combat-ready must obviously be able to perform effectively all tasks required in the accomplishment of the operational mission. However, the basic purpose of the techniques and procedures that are required is to train "pilots who already know how to fly" to employ those skills in the effective accomplishment of combat-related missions. Moreover, programs such as those at the US Army Aviation Center (USAAVNC), are available for training in non-combat related flight.

6. *Training and evaluation techniques and procedures should provide training for those aspects of performance which are the ultimate determiners of mission success.* Combat readiness should be directed at insuring that units and their assigned crews will be able to accomplish the basic objectives for which these units were established, i.e., *counter the enemy threat*. Therefore, training should be directed at, and performance evaluated in terms of, the ultimate criteria of mission successs, *not* the *potential contributer* to mission success (e.g., "survivability" or "missiles on a target" as opposed to such things as "precision in navigation").

These six requirements, along with the objective defined earlier, were used as the basis for the derivation and preliminary evaluation of the approach to training module development described in section 4.0.

4.0 APPROACH TO THE DEVELOPMENT OF TRAINING AND EVALUATION TECHNIQUES AND PROCEDURES

The following description of the approach derived for the development of training and evaluation techniques and procedures consists of two major subsections. The first, section 4.1, Guidelines for Development, defines the more fundamental features of that approach. The other, section 4.2, Procedures for Use in Training Module Development, provides a more detailed, step-by-step description of the development procedures as applied to the actual development of training modules.

4.1 GUIDELINES FOR DEVELOPMENT

This section, as noted above, defines the fundamental features of the approach to development that was derived for training and evaluation techniques and procedures module. It contains the most important results from the research conducted to date.

Briefly stated, our research indicates that the most effective approach to achieving *the greatest improvement in combat readiness in the shortest possible time* consists of adhering to a relatively limited number of guidelines in the development of the required training and evaluation techniques and procedures. These involve primarily the types of operations or tasks for which these techniques and procedures should be developed, the required structure and content of those techniques and procedures, and certain design characteristics related to usability in the field.

These guidelines, like the previously defined requirements on which they were based, were derived through extensive analytical, deductive and exploratory research efforts conducted continuously throughout the course of the research project. The objective and the different requirements were carefully analyzed to determine the implications for training module design and development. Numerous alternative module design concepts were explored in depth. Different concepts or portions of concepts were evaluated through actual or simulated development and hypothesized usage to determine their potential for the attainment of combat readiness. From these efforts, a tentative list of guidelines was derived. The implications for combat readiness training of adhering to each of these guidelines was then assessed, and modifications or deletions incorporated as deemed necessary. The resulting list was then evaluated as a whole in terms of its adequacy to meet the objectives and the requirements defined for training and evaluation techniques. Again, additions or modifications were incorporated as required.

The guidelines listed below are the result of many iterations of the above procedures. The order in which they are listed is indicative of the investigator's general assessment of their relative importance to the achievement of combat readiness.

4.1.1 Modular Design

Training and evaluation techniques and procedures should be designed as "self-contained" training modules. Training modules should be designed to be used *independently* or *in combination* with other training modules. They should be oriented around tasks or operations of sufficient scope to enable independent training with those modules to be related directly to meaningful measures of combat readiness. Modules should include techniques and procedures required for evaluation as well as for training. Therefore, techniques and procedures for performance assessment must be developed concurrently with the techniques and procedures for training.

4.1.2 Structure and Content

Training modules need not have any standardized structure or content for effective combat readiness training. The structure and content of these training modules can take any form as long as it serves to provide an improvement in the performance of selected operations or tasks. Therefore, a training module may be a detailed program with text, audio visual aids and procedures for training on a complete mission operation; it may be a technique *or device* (with instructions for use) to permit more effective practice of tasks/operations; or it may be revised procedures or aids for use in the performance of a task/operation which facilitates learning and retention of the required capability.

4.1.3 Instructions and Procedures

Training modules, regardless of their specific design, must include instructions and procedures for their use in training. Those instructions and procedures must be sufficient to insure that the training modules are used for the purposes and in the way determined by developmental testing and evaluation to be effective in providing improvements in combat readiness.

4.1.4 Combat-Unique Operations

Combat-readiness training modules should address *only combat unique* operations or tasks and/or conditions imposed by the *unique requirements of combat.* Training tasks or operations which may be required in combat missions but which are common to non-combat missions should be provided by other programs. However, a task operation which may be referred to by a title which is common to non-combat missions may have unique requirements imposed by the combat mission. For example, "takeoff" with a combat load and "takeoff" without a combat load *are not* common operations.

4.1.5 Partial Solutions

Training modules *may* be designed for, or put into use as, partial solutions to training needs. They need not meet the requirements for training on all aspects of a particular task or operation if their use can provide a significant improvement in combat readiness. A possible method for providing partial solutions early is by "exporting" completed elements of training modules for field use prior to the completion of the entire training module.

4.1.6 Multi-Mission Operations

Training modules should address, whenever possible, critical tasks/operations that have the greatest commonality among different missions. This guideline, directed at achieving widespread applicability of training modules, will reduce the number of training modules required. Use of such training modules in the field, moreover, should lead to the greatest improvement in overall combat readiness in the shortest amount of time. Terrain flight, for example, is common to most combat-oriented missions. A training module which addresses terrain flight would therefore lead to improved performance on a large number of missions rather than just one. There will, of course, be cases where training modules will be required for a single mission task. However, that should be the exception rather than the rule.

4.1.7 Condition-Oriented Operations

As an alternative to 4.1.4, training modules should be designed to address situations or environmental conditions *common to different missions*. These should be conditions which are critical to combat operations and which have a common effect on the performance of many different mission operations or tasks (e.g., night, low visibility, or operations performed in a Nuclear, Biological, Chemical (NBC) environment). Techniques and procedures should be developed which allow crews/units to *effectively* practice critical combat operations to the performance standard required in combat (e.g., navigating to and acquiring targets at NOE altitudes as demanded by combat operations) under a realistic representation (actual or simulated) of the conditions *anticipated for combat operations*.

4.1.8 "Failure Prone" Operations

Training modules should be designed to give priority to those aspects of an operation or task which *field experience has shown to be* responsible for most *failures in mission performance*. This includes those aspects of the operational task which are most difficult to learn or perform. It also includes those aspects of the operation/task which are *subject to the most rapid deterioration after learning*. There is evidence to support the position that the cognitive aspects of most operations (*knowing* what to do when), as opposed to the psychomotor skills involved, are responsible for the greatest number of mission failures.[1] It appears that crews are less likely to have attained proficiency in the cognitive aspect of an operation and/or that once proficiency is attained it deteriorates more rapidly.

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1 Mengelkoch, R. F., Adams, J. A., and Gainer, C. A. *The Forgetting of Instrument Flying Skills as a Function of the Level of Initial Proficiency*, US Naval Training Device Center, Human Engineering Technical Report NAVTRADEVCEN 71-16-18, NTDC, Port Washington, NY, 1958.

4.1.9 Contingency Operations

Training modules should be developed to provide training for contingency operations. They should provide training on those aspects of performance which are not specifically mission operation-oriented, but which are common to most missions and are critical to combat readiness. Contingency operations as used here, however, include more than just system failure. They include, but are not limited to, such things as evasion following detection by the enemy, alternatives following failure to attain initial mission objectives, and recovery from serious navigation errors (becoming lost).

4.1.10 Performance Assessment as Training

Performance assessment techniques and procedures should be designed to *facilitate training*, as well as to provide information relative to training status. As such, they should be designed, insofar as possible, to provide *immediate feedback to the crew/unit* as to the adequacy of their performance without the requirement for "external" evaluators.

4.1.11 Performance Assessment Criteria

Training modules should be designed to permit the assessment of performance in terms of criteria related to ultimate mission success (i.e., criteria related to the effects upon, or by, the adversary). This impacts upon both the scope of the operation/task addressed by the module and the definition of criteria. The operation/task for which training is provided must have sufficient scope so that improvement in performance, in terms of the defined criteria, can be validly attributed to that training. Also, the criteria for use in evaluating the effectiveness of training provided by any training module must be defined in terms of these ultimate criteria of mission success. For example, the effectiveness of a premission planning training module must be evaluated in terms of its effects on ultimate mission success, not only on the accomplishment of the premission planning operation.

4.1.12 Flexibility for Field Use

Training modules should be designed for flexibility of usage in the field to meet variations and/or changes in unit requirements. Training modules should be designed with sufficient internal modularity to permit flexibility in training emphasis on the elements of operations/tasks. They should be designed to permit their use in the training of units/crews exhibiting different degrees of proficiency on an operation/task prior to training. Training modules, to the extent possible, should not be "tied to" specific performance criteria values, or within limits, to specific system characteristics. The definition of criteria and the procedures for assessment should be specified, but the values of criteria should be amenable to change in the field. Also, task accomplishment should be defined in terms of *mission outcomes,* not the performance of *certain mission-specific procedures*.

4.1.13 Field Usability

Training modules should be designed so that they can be employed by *assigned field personnel with available resources and with the least expenditure of those resources.* Training modules should be designed so that "outside" support (other agencies or specialists) are not required in the conduct or evaluation of training. The requirement for ease and simplicity in data collection and analysis should be maximized. Techniques or procedures to permit *unit self-administered assessment* should be developed and utilized to the maximum extent possible.

4.1.14 Operational Orientation

Training modules must be designed to reflect the needs and requirements for training as viewed by operational personnel in the field. This final guideline for training module development, while of a different type than any of the above, is of sufficient importance to warrant its inclusion in the list. Training modules for combat readiness training should be developed, *from inception to final validation,* with the participation and concurrence of the *personnel who will utilize those modules.* Each stage of development should be validated in the field prior to its eventual incorporation into further development. This guideline has been followed closely in this research.

4.2 TRAINING MODULE DEVELOPMENT

This section describes the procedures determined to be effective for *implementation* of the requirements and guidelines derived for the development of training modules for combat readiness. The procedures were derived in conjunction with the development effort accomplished on this research program. The development effort included the selection of two operations for which training modules would be developed: the partial development of a training module for one of these operations, and the selection of a technique (a device) to be used in training for the other operation and around which a training module would be developed.

The procedure required for the development of combat readiness training modules is listed below and is discussed in the sections that follow.

The procedures, as listed, with the exception of the first item, are essentially equivalent to procedures specified for the ISD process.[2] It should be noted, therefore, that once we have derived the *fundamental features* of the approach, as represented in the previously described "guidelines," most of the procedures required for development are included in the ISD process.

However, the details of most of those procedures were modified, adapted, or designed to meet the specific requirement imposed by those

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[2] TRADOC Pamphlet 350-30, *Interservice Procedures for Instructional Systems Development*. Washington: Department of the Army, 1975.

guidelines. Moreover, the first procedural step--the selection of mission operation/task--is not included in the ISD process, but is one of the most important for combat-ready training module development.

1. Selection of mission operation/task

2. Identification of key task elements

3. Determination of training module design characteristics

4. Task analysis

5. Investigation of existing training materials

6. Development and evaluation of training modules

4.2.1 Selection of Mission Operation/Task

The first step required in training module development is to determine the particular mission operation/task for which training modules are required. Most aviators assigned to pilot positions in Army aviation organizations can perform satisfactorily in most of the flying tasks required of their positions, but some of the skills involved decay more quickly than others and must be practiced more often and/or more intently. Some tasks can be identified as being the most frequent causes of mission performance failure. There are some tasks which very few aviators can perform in the manner demanded by the high threat battlefield without training not now being provided. In an operational unit, any such mission operation/task that is considered a *training need* can be a candidate for module development.

However, in line with the guidelines defined previously, the present investigation sought to identify a mission operation for initial module development that would apply to several principal rotary wing combat units and, at the same time, be critically related to mission success in the high threat environment.

Two related analytic efforts proved useful for this purpose. The first consisted of an analysis of the ARTEPs relating to the various organizations employing the aeroscout, attack, and utility aircraft systems. The second involved development of a means of organizing critical aircraft system mission operations into logical training scenarios. An additional effort required for the selection involved field verification of the results derived from the analytical effort.

4.2.1.1 ARTEP Analysis

The ARTEP analysis involved examination of the ARTEPs developed for

the Attack Helicopter Battalion,[3] the Air Cavalry Squadron,[4] and the Division Combat Aviation Battalion.[5] The analysis centered on principal missions (attack, defend, delay, withdraw) as well as on functions of land combat (firepower, mobility, intelligence, command and control, combat service support). It was found that, although these aviation organizations are employed quite differently in various combat scenarios, there were some critical operations common to many missions. Among these common operations, *terrain flight* was found to be common to all missions. While terrain flight may not be the most critical combat flying task, its selection for initial module development was consistent with the intent to identify a common and critical mission operation for that development.

4.2.1.2 Training Scenarios

The other analytical effort undertaken to select a mission operation for initial development proceeded concurrently with the ARTEP analysis. This effort involved a structuring of critical mission operations into logical combat scenarios for training. The focus of the analysis was upon the Attack Helicopter Battalion. Each training scenario was designed to require no more than one-half a day for training. Table 1 shows training scenarios for the Attack and Aeroscout aircraft systems. Terrain flight operations were again found to be common to both systems.

4.2.1.3 Field Verification

Field visits were then made to verify the criticality of terrain flight operations, and to gain a better perspective of terrain flight training as conducted in the field. The following FORSCOM units were visited: 7th Combat Aviation Battalion and the 2/10 Air Cavalry Squadron, 7th Infantry Division, Fort Ord, California; 9th Combat Aviation Battalion, 3/5 Air Cavalry Squadron, 9th Infantry Division; and the 10th Combat Aviation Battalion, Fort Lewis, Washington.

Discussions with operational personnel during the visits confirmed the need for training modules to improve terrain flight operations. These discussions also pointed to another critical training need--night operations. This requirement was initially brought up with reference to its importance in terrain flight. However, more extensive discussions revealed the requirement for training in operations under nighttime conditions for almost all

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[3] ARTEP 17-385, *Army Training and Evaluation Program for Attack Helicopter Battalion*. Washington: Department of the Army, 1976.

[4] ARTEP 17-205, *Army Training and Evaluation Program for Air Cavalry Squadron*. Washington: Department of the Army, 1976.

[5] ARTEP 57-55, *Army Training and Evaluation Program for Combat Aviation Battalion*. Washington: Department of the Army, 1976.

Table 1

TRAINING SCENARIOS*

Scout Helicopter	Attack Helicopter
1. Premission Planning a) Coordination and preparation b) Mission	1. Premission Planning a) Coordination and preparation b) Mission
2. Terrain Flight	2. Terrain Flight to Battle Position
3. Recon and Target Acquisition	
4. Target Identification and Target Selection	
5. Select Battle Positions/ Firing Positions	
6. Conduct Handoff	3. Receive Handoff
7. Provide Security a) Adjust artillery b) Direct air strikes c) Provide warnings, etc.	4. Acquire Target 5. Engage Target
8. Assess Battle Damage	
9. Reengage as Necessary	6. Reengage as Necessary
10. Depart (Terrain Flight)	7. Depart (Terrain Flight)

*This example is based upon the primary mission of the Attack Helicopter Battalion.

combat-mission-related operations. The primary source of this requirement stems from the time, area and altitude restrictions imposed on night operations. These restrictions have been imposed primarily for the safety and comfort of the civilian communities located adjacent to aviation units.

4.2.1.4 Selected Operations

On the basis of the analytical efforts discussed earlier and the field confirmation of their criticality and need for training, terrain flight and night flight were selected as the operations for initial training module development.

4.2.2 Identification of Key Task Elements

Having selected a mission operation, it is then necessary to determine the elements of that operation which contribute most to the difficulty in its successful accomplishment. The ease or difficulty with which that determination may be made is largely dependent upon the complexity of the task. The more complex the task and the more subtasks it involves, the less "visible" are its task processes. As the documentation regarding its execution becomes less adequate, the greater the probability that systems operators will have differing perceptions about the relative importance of task elements. In some instances, the major source of difficulty, and therefore the most critical operational training need, may be related primarily to task performance under a specific "environmental" condition (e.g., night, adverse weather, NBC). However, it is essential that the key task elements be identified in order to concentrate the training provided by the module on those task elements that contribute most to mission success (i.e., those task elements where lack of proficiency contributes most to mission failure). Performance assessment measures must also be based upon these key elements.

4.2.2.1 Procedures for Key Element Identification

The determination of key task elements may be accomplished systematically. Such a determination requires the services of a well experienced user group. That group is asked to rank those few elements of execution of a mission operation or task that are the most common causes of failure, or which have the most serious consequences as a result of failure. The present investigation employed the Nominal Group Technique (NGT) for this purpose (Annex A). Combat Skills Phase Instructor Pilots at USAAVNC and members of aviation field units at Hunter AAF and Fort Campbell were used to determine the key task elements of terrain flight.

4.2.2.2 Key Elements

The results of these analyses showed that premission phase activities (mission planning, aircraft preparation, etc.) were consistently identified as being critical for success in terrain flying operations.

The significance of this finding should be noted. It indicates that training needs at the unit level are not always aircraft *flying skills*. The cognitive aspects (planning, decision making, etc.) of mission operation/ task performance may be just as important, if not more important, in terms of achieving combat readiness. Satisfactory mission performance is highly dependent upon cognitive skills related to knowing what to do under specific conditions. Decisional skills, such as the ability to react properly to contingency events or to changes in the tactical situation, depend upon knowledge of systems capabilities and the possible consequences of alternate courses of action.

In addition to identifying premission planning as the *operation* responsible for most problems in performing terrain flight, these groups reaffirmed the earlier findings regarding the impact night flight conditions has on the performance of terrain flight.

The results of the key element analysis therefore were twofold. First, they indicated that development efforts for the one training module should be directed at premission planning activities necessary for terrain flight rather than on the entire terrain flight operation (i.e., to develop a premission planning training module). The second result of the analysis was to reaffirm the earlier selection of night flight as the second operation for training module development.

4.2.3 Determination of Training Module Design Characteristics

Having determined from the *key element analysis* the specific mission elements, tasks or conditions for which training is required, the next step is to determine the type of training module (i.e., training design characteristics) which will be most effective in providing the required training. As noted earlier, a training module, to be most effective, need not have any preconceived design characteristics (content or structure). It does not have to be designed as a formal training program as traditionally considered to be the solution to all training requirements. It can and should be designed solely to provide maximum improvement in performance in minimum time and at minimum cost.

4.2.3.1 Performance Discrepancy Analysis

To determine the characteristics of a training module that will be most effective, one must first determine the primary cause of the *performance discrepancy*. Figure 1 shows a schematic representation of a *performance discrepancy decision model* developed for use in this analysis. It is similar to a model proposed by Mager and Pipe.[6] However, the present model was designed specifically to meet the requirements of this research.

With the above model, two avenues of analysis are explored to determine possible training module design characteristics. The first

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[6] Mager, R. F. and Pipe, P. *Analyzing Performance Problems*. Belmont, CA.: Fearson Publishers, Inc., 1970.

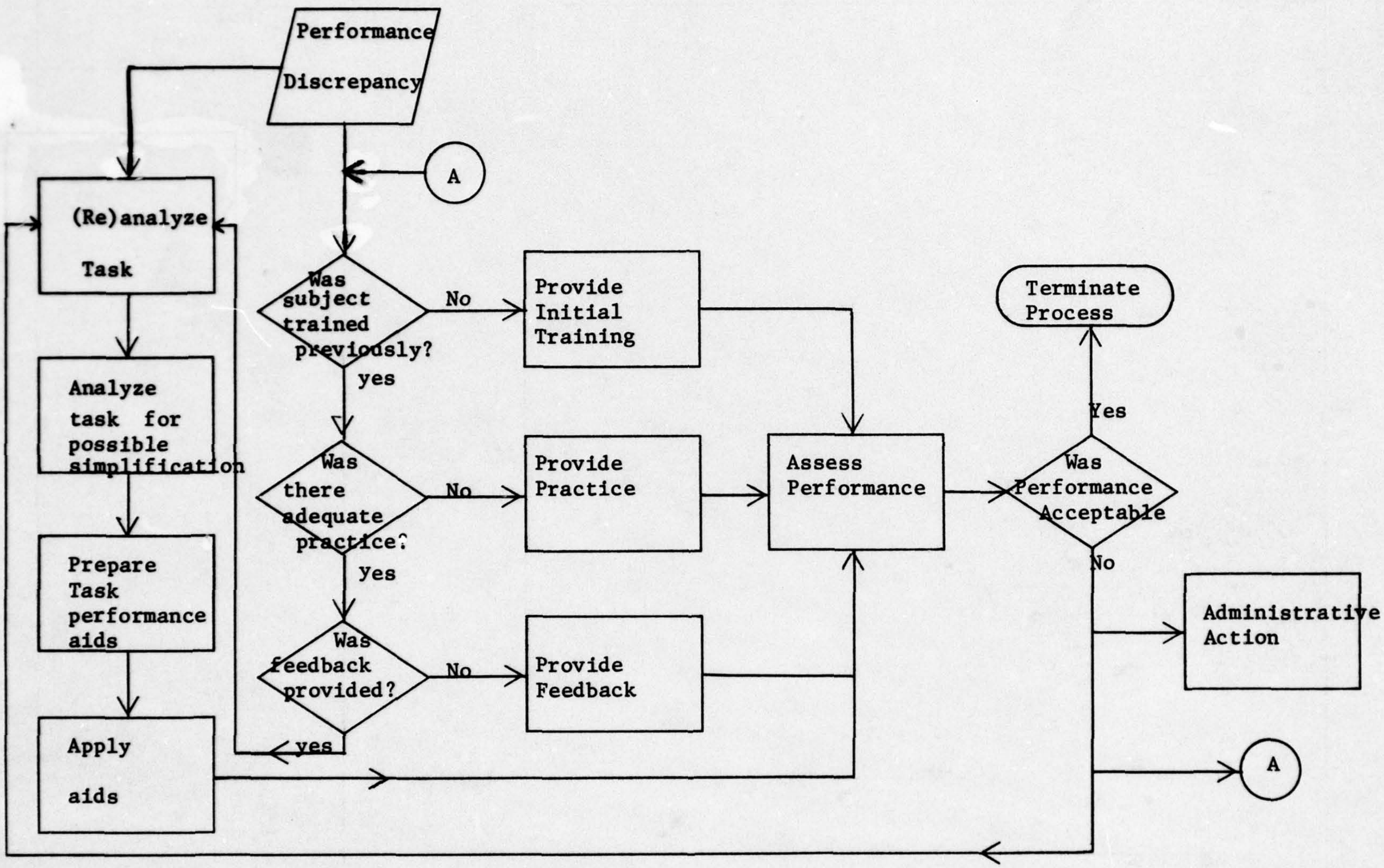

Figure 1. Schematic representation of the performance discrepancy decision model for module development.

involves possible task simplification as a means of improving performance. It may be possible to reduce the complexity and difficulty of the task, and thereby facilitate the acquisition of proficiency in performance by developing a task performance aid. The other analysis consists of a series of questions dealing with issues of previous training, adequate practice, and feedback. The required content of a module may include task performance aids, new training, practice techniques, means of providing feedback, or some combination of these. The decision points in the model enable optimal selection to increase the efficiency and effectiveness of the training module.

4.2.3.2 Essential Module Characteristics

Through the use of the performance discrepancy decision model, the essential design characteristics for training modules that would be most effective for providing training on both premission planning and night flight operations were determined. The analysis indicated that for premission planning, task simplification in the form of a job performance aid (specifically a checklist), should be the primary element of the training module. That checklist, when developed and validated, will provide the basic framework around which a complete training program would be developed.

The performance discrepancy analysis also indicated that for the night flight operations, the primary discrepancy involved the lack of opportunity to practice combat critical tasks under night conditions. Therefore, the most essential element of a training module for night flight operations would be some technique or procedure that would permit such practice.

4.2.4 Task Analysis

The next requirement for developing training modules is a detailed analysis and definition of task elements and required performance in accomplishing the mission operation. This involves the conventional and well documented task analysis procedures common to all ISD efforts.[7] Since these procedures as documented were followed in this research, their description is not required here. However, the sources of information used in that analysis are depicted in Figure 2. The analysis results in a task list which is used for further module development. The task list resulting from task analyses conducted for the present research is shown in Annex B.

4.2.4.1 Task List Verification

The validity of that list is, however, essential to the validity of the training program. Since the procedures required for validation are not common to all ISD efforts but depend upon the particular training operation, those followed in this research require delineation. The

[7] TRADOC Pamphlet, *op. cit.*

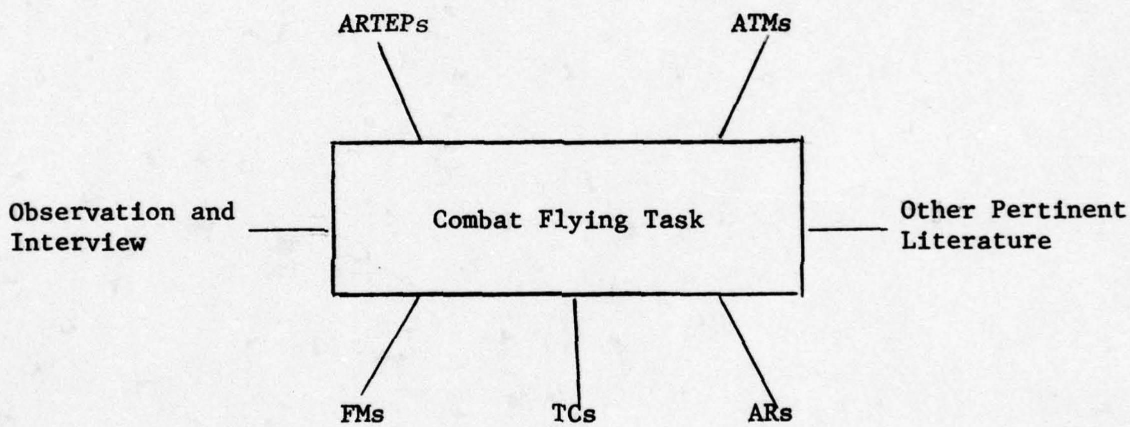

Figure 2. Sources of information which can be used in analyzing the elements of combat-related aviation tasks.

validation of the task list was accomplished in three stages. It included review by various groups of subject matter experts and operational personnel.

In Stage I, the task list was reviewed by operational units in the field who were to be users of these training modules. The following units were involved in this review: 7th Combat Aviation Battalion and the 2/10 Air Cavalry Squadron, 7th Infantry Division, Fort Ord, California; 9th Combat Aviation Battalion and the 3/5 Air Cavalry Squadron, 9th Infantry Division, and the 10th Combat Aviation Battalion, Fort Lewis, Washington.

In Stage II, the task list was subjected to review by personnel responsible for the training of new aviators who were to become the crews for aviation units in the field. This review was accomplished by personnel at the Aviation Center. A separate review, involving an analysis of the training literature used at the Center, was also conducted. The intent of these reviews was to detect any discrepancies between the task lists and current practices/doctrine being taught to new aviators.

In Stage III, the task list was reviewed by personnel responsible for the development of the ARTEPs and the ATMs which define the missions and tasks to be performed by field units.

The following personnel were involved in this review:

Personnel from the Aviation Section of Directorate of Training Developments (DTD) at the US Army Armor Center, Fort Knox, Kentucky, proponent for the Air Cavalry ARTEP, the Attack Helicopter ARTEP, and the Scout and Attack Helicopter ATMs.

Personnel from DTD at the US Army Infantry Center, Fort Benning, Georgia, proponent for the Division Combat Aviation Battalion ARTEP and the utility helicopter ATM.

Personnel from DTD at USAAVNC, Fort Rucker, Alabama, the TRADOC manager and coordinator of the ATM development project.

The results of this validation effort indicated no major discrepancies in the task list developed for terrain flight. Only minor alterations were required. The task list was revised periodically, however, to incorporate minor changes and/or refinements.

4.2.5 Investigation of Existing Training Materials

To avoid duplication of effort and to reduce the time required for training module development, existing training materials should be reviewed to determine if any are available which will satisfy or can be modified to satisfy, any required module elements.

4.2.5.1 Premission Planning

A potential source of assistance in this regard for the present investigation was the IERW Course of Instruction (COI) and other training activities at USAAVNC. Obviously, the suitability of materials must be analyzed carefully due to differences in the institutional and the field training situation. However, this would be true of any training materials developed for any purpose other than the one in question.

The review conducted at USAAVNC was extensive and involved a variety of sources and activities. These included a review of the IERW Course of Instruction and instructional materials from the Department of Academic Training, attendance at selected IERW classes, review of audio visual material available at the USAAVNC Learning Center, and a review of other materials such as service school special texts and Army training literature.

The results of this review were essentially negative. Little, if anything, was found that could be used for a premission planning training module. Differences between institutional and field training accounted for some of these results. For example, media and modes of presentation which are commonplace for institutional training are not available, or impose unacceptable logistic demands on field units. The divergent backgrounds and levels of experience for the target students/aviators also account for some of these negative results. It was concluded, therefore, that a *new* training module would have to be developed for premission planning.

4.2.5.2 Night Flight

A similar review of existing training material was conducted for night flight operations.

In this case the results were more favorable. As noted earlier, the fundamental requirement for development of a training module for night flight operations is a technique or procedure to permit practice of critical tasks under night flight conditions. This need stems from the many restrictions and limitations imposed upon night flight operations in the the areas available to field units for that training. One possible solution that is immediately suggested is simulation. One form of simulation which is economically feasible and which appears to offer a number of advantages is a device for simulating the night visual environment during day flight. It was found that such a concept had been developed by the Army Research Institute and given some preliminary testing by that organization several years ago.[8] Although the results showed much promise, the testing program was not carried far enough at that time to demonstrate the operational applicability and utility of the concept.

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[8]Farrell, J. P. Simulating Night Visual Conditions During the Day With Light Attenuating Filters. *Behavior Research Methods and Instrumentation,* 1975, 7 (6), 539-541.

The device, referred to as Light Attenuating Devices (LADs), consists of goggles, worn by the trainee, which are fitted with neutral density filters to attenuate ambient illumination. Filters covering a broad range of densities can be employed to simulate any level of "darkness" desired under any level of daylight illumination. Such a device is relatively inexpensive, readily available, and requires little or no modification for use in a night flight training module. However, additional instrument lighting in the aircraft would be desirable for certain purposes.

If the training effectiveness of this device can be demonstrated as anticipated through field evaluation, it could perhaps be used to provide night training whenever, and for whatever maneuvers, daylight training is permissible. Moreover, if the evaluation proves their effectiveness, their use for night training could offer a number of significant advantages over actual nighttime training:

- Training at lower altitudes and at lower visibility than would be permissible from a safety standpoint at night, due to the better visibility provided to the instructor/safety pilot.
- More and better training in emergency procedures, such as autorotations, is not considered safe at night.
- More realistic night navigation training due to the absence of cultural lighting.
- Reduced logistic support requirements.

While the training utility and effectiveness of this device has not yet been demonstrated, it was decided that since this concept offered such potential advantages, it should be investigated thoroughly before looking for other alternatives.

4.2.6 Development and Evaluation of Training Modules

Having determined that a new training module must be developed, the next step is to initiate the development effort. However, that development should proceed in stages, with field testing and validation between stages. The degree of development that should be achieved prior to testing and validation cannot be specified in advance and often depends on the module being developed. In general, however, where the development of one element or aspect of a module is dependent upon the validity of some other element, the latter should be validated prior to initiating development on the former.

The steps required for the development and validation of the two training modules under consideration provide an example of the above requirement.

The checklist developed for use in the premission planning training module should be tested, validated and revised as required prior to any further development. That validation effort should include the determination of the accuracy and completeness of the items on the checklist, the utility of the checklist for improving performance in actual operations, and, the effectiveness of the checklist for training in premission planning. Only when all three of these aspects of validity have been verified should further development of the training module be initiated.

In the case of the night flight operations, the training effectiveness of the devices proposed for use in training should be validated before any development effort is initiated on the training module. The devices themselves should, of course, be developed to the point where they can be safely used in testing. If their usefulness as training devices is verified, then procedures to insure optimum training effectiveness can be developed. The completed module should then be tested and validated.

One of the major advantages provided by this *staged development*, however, is that it permits the *exportation of partial solutions* that provide *improvement in combat readiness* prior to the availability of a completed module. The design of modules that provides this capability was specified as one of the *guidelines* for training module development. This guideline was given careful attention in the present research while searching for potential solutions to training needs and evaluating alternate possibilities. It was also considered in the effort directed at the development of elements of the training modules.

Both of the training modules in question offer the potential for providing this capability. Assuming positive results from the testing and evaluation described above, both the premission checklist and the goggles for use in night flight training could be put to immediate use in the field as soon as instructions for their employment were developed. However, considerable caution must be exercised to insure that bias (positive or negative) is not engendered through improper use and/or invalid assessment of their utility. Negative bias could result, for example, if field units attempted to use them for "total" solutions, when they were intended to provide training in limited areas only. On the other hand, purely "subjective" evaluations could result in positive but unwanted bias. It is highly essential therefore that precise and detailed instructions for both use and evaluation be an integral part of any training module (partial or complete) released for field use.

It is doubtful that these modules used in this manner will be as effective as they would be as part of a complete training module. However, they should provide significant improvement in performance during the period required to complete the development of the module. In addition to the advantage of early improvement in performance, their use as partial solutions will greatly increase the amount of test and evaluation data available for use in the development of the complete training module.

4.3 EVALUATION TECHNIQUES AND PROCEDURES

As specified in section 4.1, the development of evaluation (performance assessment) techniques and procedures should be accomplished concurrently with the development of training techniques and procedures. This is deemed essential since a critical element in training module development is the identification and definition of criteria for the performance of the tasks for which training is intended. The approach to assessment must be compatible with the performance criteria specified for training, and the criteria must be amenable to objective measurement with assessment procedures usable in an operational environment. This implies that performance assessment techniques and procedures can be developed only to the level of detail achieved in the training modules. As a result, in this research, only a conceptual approach to performance assessment has been derived to date. The approach would be used in developing the detailed assessment procedures to be used with the training modules under development. The essential features of that approach are described below.

Performance evaluation/assessment, whether in an institutional training situation or an operational field unit situation, serves two functions. It provides training managers/commanders with information relative to the training status of students/crews and it provides the students/crews with feedback essential for learning. However, the primary requirement for assessment in the two situations is not the same. In the institutional situation, the *primary* requirement for assessment techniques is to permit the determination of the training status and qualification of students. In the operational field situation, the *primary* requirement for assessment techniques is to enable crews to learn to perform their assigned tasks more effectively. The learning by students in the one case, and the assessment by commanders in the other, *are highly important,* but secondary requirements.

Therefore, the major *emphasis* for development of performance assessment techniques and procedures for the two purposes should be different. The development of assessment techniques and procedures for use in the operational field environment should place *primary* emphasis on methods for providing valid and timely *feedback* to crews/units as to how well they *are performing* tasks/operations critical to mission success. Moreover, these crews are continuously performing, and thereby practicing, tasks/ operations related to their assigned missions. As such, these crews are continuously learning to perform those tasks. Without adequate feedback, however, they may be learning to perform those tasks in an unsatisfactory manner.

It is not practical for IPs to accompany each crew on each mission. As such, the major requirement for the development of assessment techniques and procedures for combat readiness training is for techniques and procedures which will provide accurate information to crews/units as to whether or not *they are performing* tasks/operations in a satisfactory manner. Unit/self-assessment becomes, therefore, an essential characteristic

of an effective assessment system for combat-readiness training. This primary requirement for feedback (knowledge of results) to crews, implemented through the development of techniques and procedures for objective unit/self-assessment, would result in the satisfaction of another guideline specified for combat-readiness assessment techniques. It would permit assessment without the need for support from outside agencies.

However, the requirement for providing assessment information to commanders, even though considered secondary, must also be met. While this requirement could be met by the same information acquired for aircrew feedback, there are two additional factors to be considered in using that information for this purpose. First, commanders do not require, nor do they want, the same level of assessment detail required by the crews in order to make decisions relative to unit/crew combat-readiness and training needs. Second, information collected by units/crews relative to their performance must be reported *accurately* to the commanders.

With reference to the first of the above factors, commanders only need information relating to overall mission performance and sufficient information about crew/unit task performance to permit valid decisions regarding the type and amount of training required. If information collected by crews/units is to be used for commander assessment, techniques and procedures will be required for consolidating/integrating that information into reports that reflect tasks/operations where crews/units performance is most deficient. One possible method for achieving this is to have the units/crews "rank,"* their performance on all critical operations/tasks involved in a given mission. That is to say, crews would evaluate their performance on each task/operation in relation to their performance on all other tasks/operations of the same mission and rank those performances accordingly. This ranking would be based upon the feedback on performance provided by the techniques and procedures developed to meet the primary requirement for assessment discussed above. This ranking would provide the commander with information on the relative performance on all critical tasks/operations but without the detail available to the crews.

A second potential advantage of this technique (the one for which it was first suggested) relates to the second of the two factors noted above. It would decrease the possibility of crews/units providing "inflated" reports as to their performance. Depending upon crews/units to accurately report their "unsatisfactory" performance to their commanders could be risky unless some method were available to insure accuracy. Requiring crews/units to rank their performance on all critical task operations, regardless of whether it were satisfactory or not, would eliminate the possibility for inflated reports. Moreover, while it would not provide the commander with "absolute" information about task

*This technique was suggested by Dr. Martin Allnutt, ARI Exchange Scientist, from the Army Personnel Research Establishment, Royal Aircraft Establishment, Farnborough, Hants, England.

performance, it would indicate tasks/operations of greatest training need, which is perhaps all that would be required.

A critical issue in development of an assessment methodology, whether for providing feedback to crews or information to commanders, is the determination of the measurements that would provide the performance discriminations necessary for combat-readiness training. The performance dimensions of interest in the combat-readiness training environment are those which are direct indicators of mission performance *from the standpoint of the enemy*. These would include such measures, for example, as arrival at designated locations (en route or final), on time, and in the proper configuration; and, the avoidance of detection by the "enemy." In addition to such "mission-descriptive" measures, measures relating to critical mission tasks and operations (see key elements section 4.2.2) which determine ultimate mission performance should also be included. The development effort, therefore, should be directed at designing measurement methods that permit individual aircrews to receive direct feedback on their mission performance in relation to these dimensions.

A critical activity in assessment system development will be the identification of mission key elements for assessment and points/segments where performance on those elements should be assessed. Using a segmented assessment approach will simplify the data collection requirement, but will amplify the criticality of identifying key elements and defining tactical training scenarios. Assessment segments should be defined for each task-descriptive and mission-descriptive measure. Segments should be defined such that the performance variable of interest in a particular segment would be most critical to mission performance and, hence, more likely to discriminate performance. Segmented assessment simplifies the data analysis requirement because it will provide minimum, but sufficient, data, and it will provide that data in a logically organized format.

5.0 TRAINING MODULE DEVELOPMENT

This section describes the results of the efforts directed at the development of training modules. As noted earlier, the development effort resulted in a partial training module for premission planning and a technique to be used in training for night flight operations. In each case, however, they potentially represent a basis for providing partial solutions to training requirements. These partial solutions could be used to provide improvement in combat readiness prior to completion of the entire training modules. The entire training modules, when completed, would increase the utility of these partial solutions. Their utility for this purpose is dependent upon the results of the validation program planned as the next phase of this research.

5.1 PREMISSION PLANNING TRAINING MODULE

The initial design and development effort for the premission planning training module focused on the partial solution of task simplification. This effort has produced two versions of a checklist for premission planning, the second, an expanded version of the first. The two versions are intended for two purposes and for use by two target aviator groups. The expanded checklist is intended for use in early training and for use by less experienced aviators. The simpler version is for use in later phases of training and by more experienced aviators. These products, which form the first parts of the training module, are discussed below.

5.1.1 Premission Checklist

The premission checklist was developed as a performance aid for combat mission flight planning. Its contents were initially adapted from the premission phase of the validated terrain flying task list. In final form, its contents and format will have been thoroughly validated by operational units. It represents a way of "simplifying" the job to be done and thereby facilitating learning and retention. Annex C shows the contents of the checklist, validated by preliminary field testing, in a possible field configuration.

The premission checklist is intended to provide a logical and complete sequence for combat flight planning. Like any checklist, it is designed to eliminate the burden of remembering critical procedural activities and reduce inter- and intra-operator procedural variability. It is believed that patterning of complex sequential tasks in premission planning will be conducive to reduced error and more effective operator performance.

The checklist is structured into four sequential steps discussed in the following paragraphs: (a) acquire premission information; (b) conduct mission planning; (c) conduct contingency planning; and (d) conduct crew briefing and premission checks.

5.1.1.1 Acquire Premission Information

This step addresses the tasks of receiving the combat operation order and collecting the information and materials that will be needed during later planning steps. This information and materials include intelligence, communications, weather, maps, aerial photos, and the like. Most of these items will be acquired from the Operations Officer, but this is not noted on the checklist because of possible variations between units. Additionally, it is assumed that the mission operation order (OPORD) will be in the standard five-part format.

5.1.1.2 Conduct Mission Planning

This step addresses the tasks of planning the flight and determining other mission requirements. Flight planning includes map reconnaissance, assessment of information, selection of mode(s) of flight, selection of routes, computation of requirements, fire support coordination, and annotation of the map.

5.1.1.3 Conduct Contingency Planning

This step involves the review of procedures for handling various emergencies and contingencies that could degrade mission accomplishment. This review includes aircraft flight emergencies, systems malfunctions, loss of communications, as well as tactical contingencies, environmental contingencies, and escape routes. Some of these procedures are addressed by regulations and/or unit Standing Operating Procedures (SOP).

5.1.1.4 Conduct Crew Briefing and Premission Checks

This step addresses the briefing of the crew, standard preflight and flight checks, and additional equipment and flight checks as dictated by the given mission. It is assumed generally that procedures for standard checks are prescribed by official checklists for the aircraft system.

5.1.2 Expanded Premission Checklist

The experience levels of operational pilots vary widely. The spectrum of this experience ranges from a seasoned combat veteran, to a recent transferee to a new IERW graduate. The experienced pilot most likely will be able to plan the mission successfully with only recall reference to the premission checklist. The checklist is intended to provide organization and to aid the pilot in remembering critical procedural activities. The new pilot or the newly transferred pilot, however, may not be able to accomplish the details of the mission planning task on recall alone. There is a need to provide more detailed information for the pilot who is less than totally proficient at the mission planning task. This need was addressed by the development of an expanded premission checklist.

This expanded premission checklist is intended to provide the pilot with a consolidated reference of detailed information pertaining to each item listed in the premission checklist. It is designed with the same format as the premission checklist and provides instruction and guidance as well as reference to pertinent manuals and regulations. Reference to the expanded premission checklist is intended to provide aid in premission planning to allow safe and successful mission accomplishment. Any time a pilot is uncertain about a step in the premission checklist, reference to the expanded premission checklist is intended to provide necessary assistance.

The approach used in the expanded premission checklist is different from the premission checklist. While the premission checklist is designed to describe a necessary step to be accomplished, the expanded premission checklist is designed to provide instruction on the accomplishment of that step. For example, section one of the premission checklist tells the pilot to acquire premission information. Section one of the expanded premission checklist tells the pilot what information is needed, where to find it, and how to make effective use of this information. This format is repeated throughout. Annex D provides illustrative excerpts from a draft of the expanded premission checklist.

5.2 NIGHT FLIGHT TRAINING MODULE

The most critical requirement for training in night flight operation, as noted earlier, is the discovery or development of some method (procedure, technique or device) that will permit training on critical tasks in spite of the many restrictions and limitations imposed upon night flight operations. The solution proposed herein to meet that requirement consists of light attenuating goggles worn by the pilot during daytime flight which effectively simulates the nighttime environment. This device, if found effective for this purpose, would form the basis for future development of a complete training module for training in night flight operations.

This concept, developed by ARI some years ago, required some modification even before being used in testing for training utility and effectiveness. With the aid of ARI personnel, a device suitable for use by pilots for the required testing has been developed and procured in sufficient numbers to permit field testing. The device in its test configuration consists of the standard sand, wind and dust goggle frame in which a one-piece polycarbonate curved lens has been fitted. Two such lenses make up a set: one with a 6.0 optical density, and one with a 7.0 optical density. Simple modifications have been made to the goggle frame to block entry of light through the air vents and to make the mask fit comfortably on the nose and cheeks. A brief history of the development of the concept and of the development of this device is contained in Annex E. A more detailed technical description of the rationale for selecting the optical densities to be used in the test device is provided in Annex F.

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ANNEX A

PROCESS OF KEY ELEMENTS IDENTIFICATION:
NOMINAL GROUP TECHNIQUE

ANNEX A

PROCESS OF KEY ELEMENTS IDENTIFICATION: NOMINAL GROUP TECHNIQUE

The most immediate recourse for identification of the key elements of a task/operation is through consultation with groups of Subject Matter Experts (SMEs). Such consultation would no doubt provide significant insight as to the likely key elements of the task, but it is probable that different SMEs would have different perceptions about the relative importance of those key elements and certain counter-productive group process characteristics may inhibit the group's ability to solve the problem. The Delphi Technique has been used successfully under such circumstances, but is known to be time consuming and it does not provide for real-time intragroup discussion.

A group technique developed by Delbecq and Van de Ven[A-1], the Nominal Group Technique (NGT), overcomes a number of the counter productive group dynamic problems and shortcomings in the Delphi Technique. [For a complete discussion of the topic refer to Delbecq, Van de Ven, and Gustafson[A-2]]. NGT is a structured group meeting that proceeds generally along the format in Table A-1--given a well defined question of interest. Each step in the NGT process is associated with distinct advantages to facilitating group decision-making/problem-solving performance.

The first step, *silent generation of ideas in writing,* is intended to provide assurance that each individual's ideas will receive eventual consideration by the group. In direct contrast, conventional group discussions tend to be influenced by the ideas of those individuals with the highest status or strongest personality. Additionally, since no preliminary verbal discussion occurs about the question of interest, group members are not influenced to consider a particular dimension of the problem, thereby increasing the likelihood that more aspects of the problem (avenues of approach) will be considered.

The second step, *round-robin recording of ideas,* serves two purposes: it provides the group with a complete listing of all generated ideas; more importantly, it serves to "separate" personalities from ideas. This latter advantage is attributed to the roundrobin recording technique during which it becomes increasingly difficult for group members to remember which idea was presented by which individual.

[A-1] Delbecq, A. L. and Van de Ven, A. H. A Group Process Model for Problem Identification and Program Planning. *Journal of Applied Behavioral Sciences, 7,* 4 July - August 1971.

[A-2] Delbecq, A. L., Van de Ven, A. H., and Gustafson, D. H. *Group Technique for Program Planning: A Guide to Nominal Group and Delphi Processes.* Glenview, Illinois: Scott, Foresman, and Co., 1975.

The third step, *serial discussion for clarification,* serves to enhance the clarification of each idea without focusing on any particular idea. The discussion must be carefully controlled by the group leader to balance discussion across all items, without allowing excessive argumentation about the importance of ideas. After the entire listing of ideas has been clarified to the satisfaction of all group members, the list will have become a "group" product in which individual items will have acquired a high degree of anonymity.

The fourth step, *preliminary vote on item importance,* allows individual group members to make independent judgments about the relative importance of listed items. A voting method may involve, for example, requiring individuals to select and rank-order the ten most important items from a list of thirty. Here again, the group decision is not allowed to be adversely influenced by the high status, strong personality, or "loudest voice" individuals. Also, the pressure to "conform" to group norms is eliminated because voting is done independently. After the vote has been taken, the results are posted so that the group may examine the outcome.

The fifth step, *discussion of preliminary vote,* is intended to increase the judgmental accuracy of the group. It allows the group to examine inconsistent voting patterns and provide an opportunity to rediscuss items that are perceived as receiving too many, or too few, votes. For example, one item may have been ranked high (e.g., 10) by one individual and low (e.g., 1) by another. It may be worthwhile in that instance to rediscuss an item with such split votes, to be sure that the differences are not caused by a misunderstanding of the item.

The sixth step, *final vote,* aggregates individual judgments into a final group decision. The final vote provides a sense of closure and accomplishment to the group members. The final output is perceived by members to be a group product, rather than the thoughts of a few dominant individuals whose ideas may be in direct opposition to those of the less dominant individuals.

Table A-1

FORMAT FOR NOMINAL GROUP TECHNIQUE

1. *Silent generation of ideas in writing:* Group members write key ideas silently, independently, and concisely in response to the question of interest.

2. *Round-robin recording of ideas:* The group leader asks for a single idea from one member at a time and writes that idea on a flip chart visible to the group until all ideas are exhausted. No discussion of ideas should occur at this time.

3. *Serial discussion for clarification:* A short period of time is allowed for the discussion of each listed idea without unduly focusing on any particular idea. Group members will come to understand the meaning of, logic behind, and arguments for and against each idea. This clarification may lead to the combination and/or elimination of redundant ideas. The central object of this step is to clarify, not to win arguments about the relative importance of ideas.

4. *Preliminary vote on item importance:* Through the use of a structured voting process, the group aggregates the judgments of individual members to determine the relative importance of individual items.

5. *Discussion of the preliminary vote:* This brief step allows members to examine inconsistent voting patterns and rediscuss items which are perceived as receiving too many or too few votes.

6. *Final vote:* The final voting determines the outcome of the meeting and documents the group judgment.

ANNEX B

TERRAIN FLIGHT TASK LIST

ANNEX B

TERRAIN FLIGHT TASK LIST

I. Premission Phase

A. Acquire Premission Information

B. Conduct Mission Planning

C. Conduct Contingency Planning

D. Conduct Premission Checks

I. Premission Phase

A. Acquire Premission Information

1. Receive operation order

2. Receive and/or request supplemental/update information regarding:

a. Intelligence

(1) Friendly forces
(2) Enemy forces

Particular emphasis on: TAC Air, Air Defense Artillery, and Artillery

(3) Conditions

(a) EW

(b) NBC

b. Communications

(1) Radio

(a) Current CEOI

(b) Frequencies

(c) Call signs

(2) Visual

c. Weather (cloud cover, restrictions to visibility, temperature, wind, turbulence, and forecast conditions)

(1) At takeoff

(2) En route

(3) Destination and alternates

3. Obtain materials:

a. Maps

b. Aerial photographs

c. Overlays, etc.

I. Premission Phase

B. Conduct Mission Planning

1. Plan the flight with reference to:

a. Mission

b. Weather

c. Forces

(1) Enemy

(2) Friendly

d. Terrain

(1) Flight factors

(2) Factors of enemy disposition

2. Plan the route(s)

a. Conduct map and/or aerial photo reconnaissance

b. Review reports (enemy/friendly disposition)

c. Assess:

(1) Effects of weather and lighting

(2) Force deployments

(a) Friendly

(b) Threat

(3) Terrain

(a) Navigational features

(b) Hazards

(c) Tactical aspects

1. Masking features

2. Potential enemy positions

(4) Radio navigation

(a) Reference station location

(b) Frequencies

(c) Restrictions to range

(d) Continuous/intermittent operation

d. Select mode(s) of flight:

(1) Terrain

(2) Instrument

(3) Unrestricted

e. Select routes:

(1) Main

(2) Alternate(s)

f. Compute/determine:

(1) Time

(2) Distance

(3) Expected airspeeds

(4) Expected altitudes

(5) Fuel requirements

g. Annotate map or overlay including:

(1) Routes

(a) Course lines

(b) Boundaries

(c) Flight corridors

(d) Magnetic markings

(e) Mileage tic mark

(f) Critical turns with magnetic headings

(g) Map elevations at key points

(2) LZs

(3) FEBA

(4) Force locations

(a) Enemy

(b) Friendly

(5) Checkpoints

(6) ACPs

(7) FARRP

(8) Radio navigation aids

(a) Reference station location

(b) Frequencies and identifiers

(c) Mode of operation

(d) Times of operation

(9) Hazards

3. Determine command structure (determine flight/element leader, PIC)

4. Determine threat suppression requirements:

   a. Suppressive fires

   b. Air strikes

   c. Chaff or smoke

   d. Stand-off jamming

5. Determine mission-specific equipment

6. Brief crew

   a. Describe mission

   b. Discuss flight plan

   c. Specify personal equipment requirements

d. Assign crew responsibilities:

(1) Preflight

(2) Flight

e. Brief passengers if applicable

I. Premission Phase

C. Conduct Contingency Planning

1. Review procedures for aircraft inflight emergencies, systems malfunctions, loss of communications, etc.

2. Review procedures for tactical contingencies:

a. Mission change

b. Enemy sighting

c. EW

d. FARRP (not there, unusable)

e. Change in enemy situation

f. Enemy induced aircraft damage and/or crew injury

g. Additional tactical contingencies

3. Review procedures for environmental contingencies:

a. Weather related

b. Tactical related (NBC, battle induced smoke, etc.)

4. Plan escape route:

a. In air

b. On ground - if downed

5. Brief crew

a. Assign emergency and contingency plan crew duties and responsibilities

b. Verify common terminology

I. Premission Phase

D. Conduct Premission Checks

1. Perform Standard checks:

a. A/C weight and balance; performance limitations data (charts)

b. Airframe

c. Systems

d. POL

e. On-board equipment

f. Personal equipment (survival, weapons, safety)

2. Perform mission equipment check:

a. Armament

b. NVGs

c. Special aircraft configuration (e.g., light masking for night flight)

d. Other mission-specific equipment (slings, nets, etc.)

3. Perform A/C flight checks:

a. Systems

b. Go/no-go check

(1) Ground effect hover

(2) Out-of-ground-effect hover - downwind

(3) 360° pedal turn - left turn more demanding

II. Terrain Flight: Execution Phase

A. Exercise Navigation Skill

B. Exercise Teamwork

C. Exercise Flying Skill

D. Recognize and React to Contingencies

E. Use Terrain for Concealment

F. Execute Communication Techniques

II. Terrain Flight: Execution Phase

A. Exercise Navigation Skill

1. Execute navigation according to flight plan

a. Maintain orientation

(1) Recognize terrain features

(2) Correlate terrain with map

b. Determine location

(1) Use ground reference:

(a) Bearing(s)

(b) Distance

(c) Altitude

(2) Use situation reference:

(a) Other A/C

(b) Enemy

(c) LZ

c. Project/anticipate end of segments by:

(1) Checkpoints

(2) Indirect measures

(a) Time

(b) Bearing(s) to feature(s)

2. Execute navigation under unplanned conditions

a. Conduct route change:

(1) Tactical situation

(2) Unanticipated terrain/environmental conditions (e.g., weather and light)

b. Conduct en route mission change

3. Execute radio navigation

    a. Frequencies and identifiers

    b. Mode of operation

    c. Times of operation

    d. Referenced station location(s)

II. Terrain Flight: Execution Phase

B. Exercise Teamwork

1. Employ division of duties (in accordance with premission phase)

2. Execute internal communications

    a. Use standard terminology and phraseology

    b. Provide information in a timely manner (For example, navigator keeps pilot informed as to his location relative to known points (e.g., LZ))

3. Respond promptly to direction and requests for information

II. Terrain Flight: Execution Phase

C. Exercise Flying Skill

1. Execute takeoff as appropriate to mission and condition

2. Operate in selected Terrain Flight Mode

   a. Low level

   b. Contour

   c. NOE (NOE maneuvers of particular importance are quick stop/ deceleration and clearance estimation tasks).

3. Perform multi-helicopter operations

   a. Traveling

   b. Traveling overwatch

   c. Bounding overwatch

4. Change mode of flight en route

5. Execute approach as appropriate to mission and condition

   a. Conduct reconnaissance of area

   b. Perform approach as situation dictates

II. Terrain Flight: Execution Phase

D. Recognize and React to Contingencies

1. Flight emergencies, systems malfunctions, loss of communication, etc.

2. Tactical contingencies

   a. Mission change

   b. Enemy sighting

   c. EW

   d. FARRP (Not there/unuseable)

   e. Change in enemy situation

   f. Enemy induced A/C damage or crew injury

   g. Other tactical contingencies

3. Environmental contingencies

   a. Weather related

   b. Tactical related (NBC, battle induced smoke, etc.)

II. Terrain Flight: Execution Phase

E. Use Terrain for Concealment

1. Apply terrain and vegetation considerations

a. Cross ridgelines at lowest points

b. Cross open flat areas at narrowest points

c. When paralleling a vegetated area fly below and near the vegetation

d. Decrease altitude when overflying fields and other open areas

e. Hover and land whenever necessary to reconnoiter an area

f. Mask/unmask when necessary for observation

g. Avoid hovering where dust may reveal position

2. Apply tactical considerations

a. Interpret enemy sightings

(1) For immediate use

(2) Unplanned intelligence gathering

b. Avoid known threat locations

c. Apply premission tactical terrain analysis

II. Terrain Flight: Execution Phase

F. Execute Communication Techniques

1. Use equipment and systems

a. Radio

(1) UHF

(2) VHF

(3) Speech security equipment

(4) Transponder/IFF

(5) Radar warning device

b. Visual

(1) Lights

(2) Mechanical (panels, flags, etc.)

(3) Pyrotechnics

(4) Hand and arm

(5) Aircraft maneuvers

2. Use techniques

a. Employ radio communications IAW:

(1) Standard message conventions (terminology and phraseology)

(2) CEOI and/or Unit SOP

(3) Signal security methods (as appropriate: codes, ciphers, authentication systems, etc.)

(4) Mission specific applications

b. Employ visual communications IAW:

(1) Standard message conventions

(2) CEOI and/or Unit SOP

(3) Signal security methods (as appropriate: codes, authentication systems, etc.)

(4) Mission specific applications

ANNEX C

PREMISSION CHECKLIST

POSSIBLE FIELD CONFIGURATION
KNEEBOARD-SIZE CARD

ACQUIRE PREMISSION INFORMATION (I)

1. RECEIVE OPERATION ORDER

2. ACQUIRE SUPPLEMENTAL/UPDATE INFO:
   - A. INTELLIGENCE
     - ENEMY FORCES
     - FRIENDLY FORCES
     - CONDITIONS (EW & NBC)
   - B. COMMUNICATIONS
     - RADIO
     - VISUAL
   - C. WEATHER
     - AT TAKEOFF
     - EN ROUTE
     - DESTINATION & ALTERNATES

3. OBTAIN MATERIALS
   - A. MAPS
   - B. AERIAL PHOTOS
   - C. OVERLAYS, ETC.

CONDUCT MISSION PLANNING (II)

1. PLAN THE FLIGHT
   - A. CONDUCT MAP & AERIAL PHOTO RECON
   - B. REVIEW ENEMY/FRIENDLY REPORTS
   - C. ASSESS:
     - MISSION REQUIREMENTS
     - EFFECTS OF WEATHER & LIGHTING
     - ENEMY/FRIENDLY FORCE DEPLOYMENTS
     - TIME AVAILABLE FOR PLANNING
     - TERRAIN
       - --NAV FEATURES
       - --HAZARDS TO TERRAIN FLIGHT
       - --TACTICAL ASPECTS MASKING FEATURES, POTENTIAL ENEMY POSITIONS
     - RADIO NAVIGATION
       - --REFERENCE STATION LOCATION
       - --FREQUENCIES
       - --RESTRICTIONS TO RANGE
       - --TIMES OF OPERATION
   - D. SELECT MODE(S) OF FLIGHT:
     - TERRAIN
     - INSTRUMENT
     - UNRESTRICTED
   - E. SELECT ROUTES:
     - MAIN
     - ALTERNATE(S)
   - F. COMPUTE/DETERMINE
     - TIME OF FLIGHT
     - DISTANCE
     - EXPECTED AIRSPEEDS
     - EXPECTED ALTITUDES
     - FUEL REQUIREMENTS
   - G. FIRE SUPPORT COORDINATION
     - PREPLANNED TARGETS
     - ARTILLERY AIR CORRIDORS
     - SUPPORTING UNITS
   - H. ANNOTATE MAP OR OVERLAY
     - ROUTES
       - --COURSE LINE
       - --BOUNDARIES
       - --FLIGHT CORRIDORS
       - --MAGNETIC MARKINGS
       - --MILEAGE TIC MARKS
       - --CRITICAL TURNS WITH MAG HEADING
       - --ELEVATION OF KEY POINTS
     - FEBA
     - ENEMY/PREPLANNED ARTILLERY TARGETS
     - CHECKPOINTS
     - ACPs
     - RADIO NAV AIDS
       - --REFERENCE STATION LOCATION
     - HAZARDS

2. DETERMINE COMMAND STRUCTURE

3. DETERMINE THREAT SUPPRESSION REQUIREMENTS
   - SUPPRESSIVE FIRES
   - AIR STRIKES
   - NAVAL AIR FIRE
   - SMOKE

4. DETERMINE MISSION-SPECIFIC EQUIPMENT

PREMISSION CHECKLIST (PAGE 1, FRONT)
POSSIBLE FIELD CONFIGURATION
KNEEBOARD-SIZE CARD

CONDUCT CONTINGENCY PLANNING (III)

1. REVIEW PROCEDURES FOR:
   - A. AIRCRAFT INFLIGHT EMERGENCIES
   - B. SYSTEMS MALFUNCTIONS
   - C. COMMUNICATIONS LOSS, ETC.
2. REVIEW PROCEDURES FOR TACTICAL CONTINGENCIES:
   - A. ENEMY SIGHTING
   - B. EW
   - C. FARRP (NOT THERE, UNUSABLE)
   - D. CHANGE IN ENEMY SITUATION
   - E. ENEMY INDUCED AIRCRAFT DAMAGE AND/OR CREW INJURY
   - F. MISSION CHANGE
   - G. ADDITIONAL TACTICAL CONTINGENCIES
3. REVIEW PROCEDURES FOR ENVIRONMENTAL CONTINGENCIES:
   - A. WEATHER RELATED
   - B. TACTICAL RELATED (NBC, SMOKE, ETC.)
4. PLAN ESCAPE ROUTE
   - A. IN AIR
   - B. ON GROUND - IF DOWNED

CONDUCT CREW BRIEFING AND PREMISSION CHECKS (IV)

1. BRIEF CREW
   - A. MISSION
   - B. SITUATION
     - ENEMY/FRIENDLY
     - WEATHER/TERRAIN
     - CONDITIONS (EW, NBC)
   - C. PLAN OF OPERATION
     - FLIGHT PLAN
     - FIRE SUPPORT PLAN
     - SCHEDULE/COORDINATION
     - CONTINGENCY PLAN
   - D. COMMUNICATION
     - RADIO
     - VISUAL
   - E. COMMAND STRUCTURE
   - F. PERSONAL EQUIPMENT REQUIREMENTS
   - G. CREW DUTIES RESPONSIBILITIES
     - PREFLIGHT
     - FLIGHT
     - CONTINGENCY/EMERGENCY
   - H. SUPPORT
     - POL
     - ARMAMENT
     - RATIONS
     - RELIEF
     - MAINTENANCE/RECOVERY
     - MEDIVAC
   - I. PASSENGERS BRIEFING IF APPLICABLE
2. PERFORM STANDARD CHECKS:
   - A. AIRCRAFT WEIGHT AND BALANCE: PERFORMANCE LIMITATIONS DATA CHARTS
   - B. AIRFRAME
   - C. SYSTEMS
   - D. POL
   - E. ON-BOARD EQUIPMENT
   - F. PERSONAL EQUIPMENT SURVIVAL, WEAPONS, SAFETY
3. PERFORM MISSION EQUIPMENT CHECK:
   - A. ARMAMENT
   - B. NVGs
   - C. SPECIAL AIRCRAFT CONFIGURATION (MASKING FOR NIGHT FLIGHT, ETC.)
   - D. OTHER MISSION-SPECIFIC EQUIPMENT (SLINGS, NETS, ETC.)
4. PERFORM AIRCRAFT FLIGHT CHECKS:
   - A. SYSTEMS
   - B. GO/NO-GO POWER CHECK
     - GROUND EFFECT HOVER
     - OGE HOVER - DOWNWIND
     - 360 LEFT PEDAL TURN

PREMISSION CHECKLIST (PAGE 2, BACK)
POSSIBLE FIELD CONFIGURATION
KNEEBOARD-SIZE CARD

ANNEX D

EXPANDED PREMISSION CHECKLIST

ANNEX D
EXPANDED PREMISSION CHECKLIST

The purpose of this expanded checklist is to provide a consolidated reference for mission planning. It is formatted to correspond to each item listed in the Premission Checklist. Reference to this expanded checklist will provide the information necessary to conduct a safe and successful mission. Because this is a consolidation, there are some procedures and techniques that will be either redundant or unnecessary depending on the particular mission. Final responsibility for determining which procedures and techniques apply to each mission, as always, rests with the pilot. There will also be times when all of the information needed is not found in obvious places. This checklist provides a guide to finding that information.

The person responsible for providing you, the pilot, with the materials you need, is the operations officer. In almost every instance the operations officer at the Tactical Operations Center (TOC) is the person to contact for additional or supplemental information and materials.

1. RECEIVE OPERATIONS ORDER

The first step in mission planning is to receive the operations order. This order usually is obtained from the operations officer and it can be presented to you in any of the following three formats.

a. the entire order; where the pilot must extract the information pertinent to his mission by himself

b. an oral order from the operations officer which will contain only the information pertaining to the pilot's mission

c. a written "Frag" order which will also contain only the information pertaining to the specific mission

The following is an outline of the information contained in the operations order. You may receive part or all of this information. Be familiar with the information provided in the operations order. The possibility exists that you may need more detail than the oral or frag orders provide for you (see Figure D-1).

2. ACQUIRE SUPPLEMENTAL/UPDATE INFORMATION

Additional information is found mainly in the operations order. Either obtain the order itself or direct your questions to the operations officer.

The first step after receiving the operations order is to analyze the operations map. This map is annotated with the locations of every pertinent detail of the area (anti-aircraft emplacements, mine fields, field hospitals, division headquarters, etc.).

(CLASSIFICATION)

(Change from oral orders)

Copy No. __ of __ copies
Issuing Headquarters
Location of Issuing HQ
Date Time Group
Message Reference No.

OPORD (Serial Number/Code Name)
References
Time Zone Used Throughout the Order:

Task Organization:

1. SITUATION
   a. Enemy Forces
   b. Friendly Forces
   c. Attachments and Detachments
   d. Assumptions

2. MISSION

3. EXECUTION
   a. Concept of Operation
   b. This subparagraph and subsequent subparagraphs list tasks assigned to subordinate units as applicable.
      . Reserve (if applicable)
      . Coordinating Instructions. (This is the last subparagraph) (Statement of when the plan will become effective.)

4. SERVICE SUPPORT

5. COMMAND AND SIGNAL
   a. Signal
   b. Command
   c. Axis of command post displacement (if not shown graphically)

Acknowledgement Instructions.

Commander's Last Name
Commander's Grade

Authentication*
Annexes
Distribution

*Used only when applicable

(CLASSIFICATION)

Figure D-1. Sample format of operations order (OPORD)

The next step is to obtain the intelligence summary (published daily). Normally, the operations officer will have already extracted the necessary supplemental information. Additional information on the enemy can be obtained from pilots who have flown similar missions. The intelligence summary contains information about the enemy. Friendly forces usually are not included in this report.

A. Intelligence

1. Enemy Forces. Paragraph 1a of the operations order contains information of the enemy that is likely to affect accomplishment of the mission. This subparagraph should contain factual information and may be supplemented by or refer to a published intelligence annex, a periodic intelligence report, or an intelligence summary. If practical, the subparagraph may consist only of such references. The enemy situation may be shown on the operation overlay if it does not detract from the graphic portrayal of the scheme of maneuver. When it is desirable or necessary to include information of the enemy in the order, this information is given in the following sequence:

a. Items pertaining to the enemy situation (composition, disposition, location, movement, morale, strength, status of supplies).

b. Enemy capabilities.

c. Enemy's most probable course(s) of action.

2. Friendly Forces. Information on friendly forces is found mainly in the operations order. Additional information obtained through pilots, platoon leaders, and section leaders can be obtained from the operations officer. Paragraph 1b of the operations order will include information of the next higher unit, adjacent units, and units that are not organic, operation control, assigned or attached but have a supporting role that may affect the accomplishment of the mission. Priority work accomplishment for direct support units may be included in this subparagraph with the exception of artillery. Listing of friendly forces is in a definite sequence, as follows:

a. Higher units (minimum, next higher unit)

b. Adjacent units

c. Supporting units (units in Direct Support, General Support)

(1) Following force of next higher command (reserve)

(2) Artillery units in numerical or alphabetical order (field artillery first, followed by air defense artillery)

(3) Remainder in any order

3. Conditions. Any unusual or unexpected condition which may be encountered on the battlefield such as electronic warfare or nuclear, chemical or biological contamination will be posted on the operations map. Additional information on jamming and electronic deception can be found in the MEJI (Meaconing, Intrusion, Jamming, and Interference) report. This report may not always be available due to its classification of SECRET or higher. For additional information refer to FM 101-5-1.

B. COMMUNICATIONS

Air-to-ground communication is significantly restricted if not impossible in the terrain flying environment. When operating at terrain flight altitudes, masking between the helicopter and the ground station occurs. As a result, radios (e.g., FM, VHF, UHF) which require line-of-sight propagation become unreliable. Although HF radio is not limited to line-of-sight propagation, it is not always reliable. Variations in both the ground and sky wave occur causing erratic operations. By constructing a terrain profile, it can be determined at what locations along the route radio communications could best be achieved. By predetermining these points, prearranged signals can be transmitted as the aircraft passes these positions. Because communications are seriously limited during terrain flight, detailed planning must be effected to insure that the mission can be accomplished without radio communications with the ground station. Visual communication signals which will allow the air mission commander (AMC) to control the flight when radio silence is required must be established and become a part of the unit's SOP.

(a) Radio

Information pertaining to radio call signs and frequencies normally are presented in paragraph 5 (command and signal) of the operations order.

(b) Visual

Visual signals and use of pyrotechnics are provided in the Communication-Electronic Operating Instructions (CEOI). In addition, each unit has published its own Standing Operating Procedure (SOP) for visual signals.

C. WEATHER

Weather information is obtained through the operations officer. Requirements for VFR flight, landing and selection of alternates are listed below (reference AR 95-1).

Table D-1

VFR Weather Minima
(Uncontrolled Airspace)

Operation	Ceiling	Visibility R/W	Visibility F/W
Daylight:			
Over flat terrain	300	1/2 mile	1 mile
Over mountainous terrain	500	1/2 mile	1 mile
Night:			
Over flat terrain	500	1 mile	2 miles
Over mountainous terrain	1000	1 mile	3 miles

3. OBTAIN MATERIALS

Maps, aerial photos and overlays will be provided for you by the operations officer.

A. MAPS

A 1:100,000 or larger (VFR Sectional or 1:250,000) contour map should be used to cover your entire route and a 1:50,000 scale should be used in your area of operation.

B. AERIAL PHOTOS

Pay particular attention to hazards such as enemy positions or gun emplacements. Check for recent changes that are not indicated on the maps.

C. OVERLAYS

Onionskin overlays provide detailed information pertaining to the battlefield. Use the grid coordinates to align the overlay over the area of operations and mark the information pertaining to your mission. The overlays are your primary guide to the location of friendly forces boundaries (see Figure D-2).

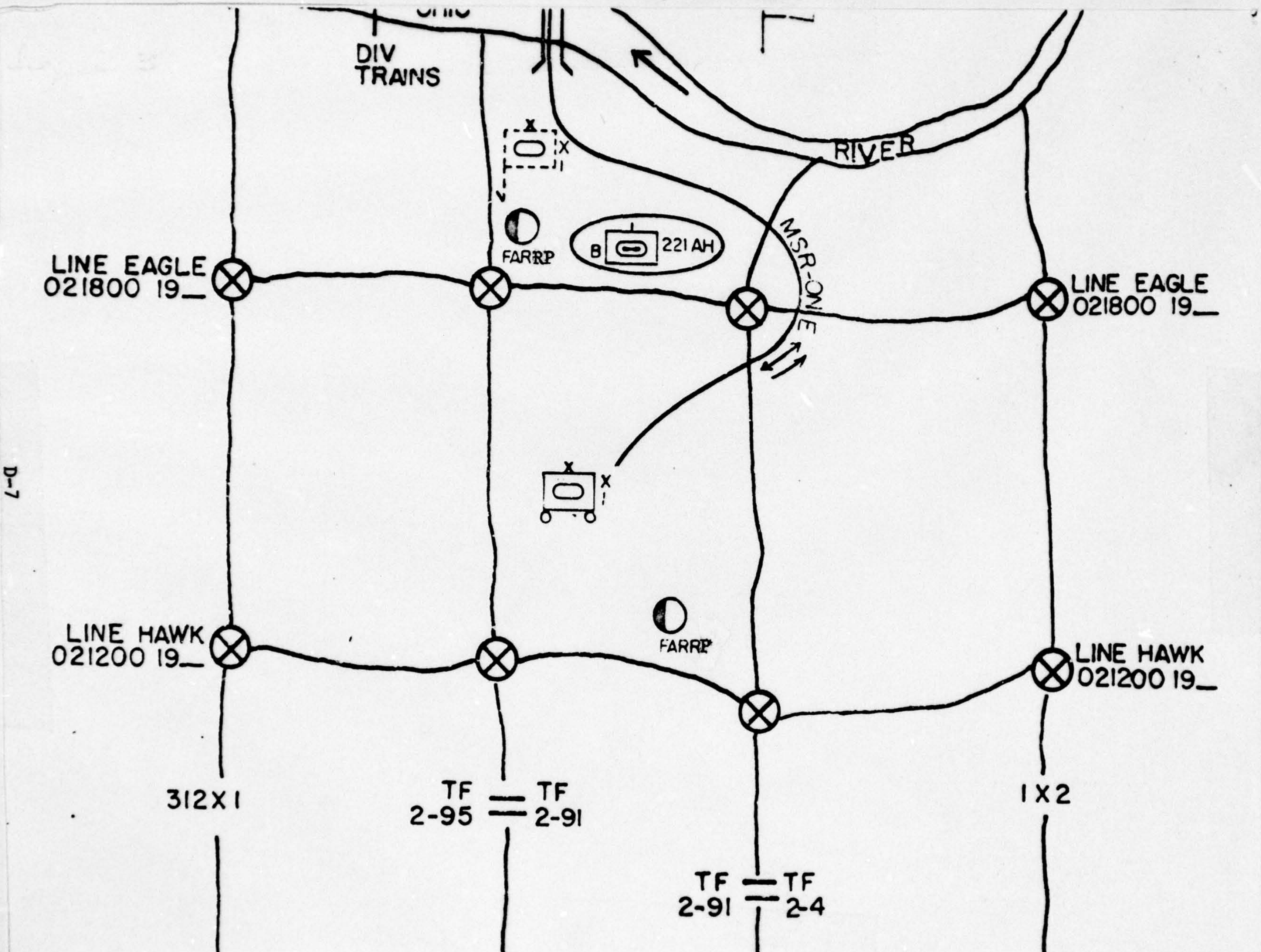

Figure D-2. Map Overlay

ANNEX E

HISTORY AND DESCRIPTION OF THE DEVELOPMENT OF THE LIGHT ATTENUATING DEVICE FOR TESTING AND POSSIBLE USE AS A PART OF A NIGHT FLIGHT TRAINING MODULE

ANNEX E

HISTORY AND DESCRIPTION OF THE DEVELOPMENT OF THE LIGHT ATTENUATING DEVICE FOR TESTING AND POSSIBLE USE AS A PART OF A NIGHT FLIGHT TRAINING MODULE

History and Description of the Goggles

As early as 1954, scientists were reporting investigations into simulating night flying (visual) conditions during daylight hours. In one report, Horn[E-1], defined the ideal range of filters for use on a "bright, clear" day as having optical densities of ND 5.2 to ND 5.8. He stated further that a density of ND 5.4 could simulate all night weather conditions when training in corresponding day weather conditions. Horn also noted problems concerned with the requirement for a light-tight fit of the goggles and the concomitant requirement for venting if rapid "fogging" is to be avoided.

In 1975, Farrell[E-2] reported the use of various filter materials, and a unique bi-density lens incorporating an upper area density of ND 5.1 and a lower area density of ND 3.5. The lens was mounted in a standard military sand, wind and dust goggle and designed for use by helicopter pilots. The purpose of the lower lens area was to provide visual access to the aircraft instruments. Farrell chose the ND 5.1 density as pilots reported the perceptual equivalent of a full moon on a clear night. He stipulated the use of a density of ND 5.5 for simulating a much darker night (some stars but no moon). Farrell also reported difficulty with fogging and that the lenses used were too fragile and expensive for field application. Army Research Institute investigators, however, continued their investigations of this technology, but with the emphasis on providing devices which might prove useful in training of riflemen, tank and truck drivers and other ground troops for night operations.

In 1978, Bleda and Johnson[E-3] reported preparations for large-scale testing of a commercial welder's goggle-mounted light attenuating filter to be used in improving rifle marksmanship accuracy at night for Army trainees at Fort Jackson, South Carolina. Subsequently, Bleda and Bleda[E-4] reported the success of this project. The use of Light Attenuating Devices (LADs) provided training which transferred immediately and enhanced long term retention of markmanship skills. Training conducted with them is being projected to result in significant savings in the manpower required to support actual night training versus that required of simulated night training conducted during the day.

[E-1] Horn, R. E. *A Method for Simulated Night Flying During Daylight Hours*. WADC Technical Report 54-505, Wright Air Development Center, Wright Patterson AFB, October 1954.

[E-2] Farrell, J. P. Simulating Night Visual Conditions During the Day With Light Attenuating Filters. *Behavior Research Methods and Instrumentation,* 7(6), 1975, 539-541.

[E-3] Bleda, P. R. and Johnson, T. M. The Goggles That Turn Off The Sun. *Army,* March 1978, 36-39.

[E-4] Bleda, P. R. and Bleda, S. E. Night Training During the Day With LADs. Unpublished manuscript prepared for publication in *Army,* June 1978.

The goggles used by Bleda and Johnson[E-5] in the Fort Jackson experiments were not considered suitable for use by Army Aviators for a number of reasons. A principal factor was the goggles' lateral restrictions on the field of view. However, the standard sand, wind and dust goggles have been found to provide an adequate field of view for aviators. For this reason, in the Spring of 1978, Drs. Hyman and Bleda[E-6], ARI Headquarters, were asked to provide a filter mounted in the standard goggle. Figure E-1 is a photograph of these goggles.

The request required some modifications to be made. The filters had been prepared to be mounted in the standard gas mask. To be able to fit them to the standard goggle, they were attached through use of small bolts, to a clear plastic lens cut to fit the goggles. The problem of passage of transient light through the edges was resolved by blocking with opaque tape. The filters had an optical density of ND 5.1. They were manufactured by Omnitech Corp. of Southbridge, Massachusetts. Omnitech also provided five other neutral density plastic lenses, but in the same shape as the clear lens with which the standard sand, wind, and dust goggles are fitted. These had optical densities ranging from ND .56 to ND .91 and are shown in Figure E-2.

Preliminary Evaluation and Modification

Experimentation began immediately on use of the goggles by experienced pilots qualified in both night and day terrain flight. Very early in the experimentation process, it was found that the goggles could be worn with the headstrap outside the flying helmet. In this way, additional filters could be mounted in front of the basic lens in order to increase the resultant optical density. Figure E-2 depicts this arrangement. This mounting was a relatively simple operation which could be conducted in flight, either with or without removing the goggles. If the goggles were removed, the pilot would keep his eyes shut with gloved hands over them until the goggles were again fitted. With this procedure, there has been very little, if any, reported loss in dark adaptation.

This preliminary experimentation was pointed primarily to exposing experienced pilots to the visual simulation provided by the goggles to: (a) test fidelity subjectively: (b) verify the optical density recommendations of the literature; (c) determine acceptability by aviators and instructor pilots; and (d) identify any obvious strengths or weaknesses in the approach. Flights were conducted in several low level flying areas under weather conditions varying from clear, bright sunlight to overcast with low clouds and heavy rain.

Aside from variations in reported perceptions of the brightness of the night scenes experienced, the pilots were unanimous in their expressions that the visual experience with the device was essentially the same as flying at night.

[E-5] Bleda and Johnson, *op. cit.*

[E-6] Hyman, A. and Bleda, P. R. Personal communication, April 1978.

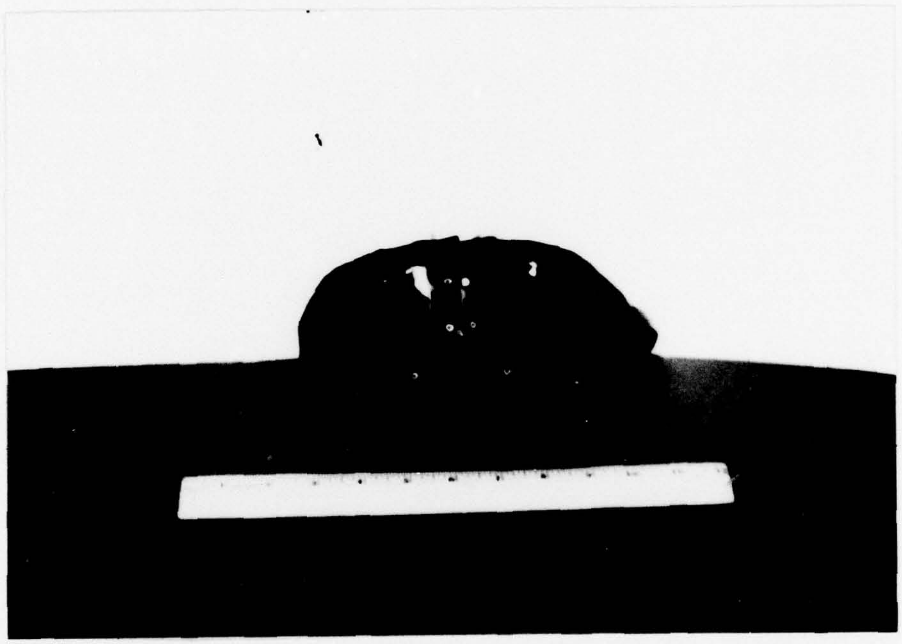

Figure E-1. Standard sand, wind and dust goggles fitted with ND 5.1 filters. The configuration shown in the figure employs filters, originally designed for use in the standard gas mask, bolted to a clear plastic lens. Opaque tape around the edges of the filters was used to block transient light passage.

FigureE-2. Standard sand, wind and dust goggles fitted with ND 6.0 filter. The configuration shown in the figure employs a lens design that accepts additional exterior-mounted filters to increase resultant optical density. Also shown are four additional filters ranging in densities from ND .56 to ND .91.

In June 1978, the preliminary experimentation was extended to include pilots and commanders of combat aviation organizations at Forts Lewis and Ord. As these experiments continued, it became increasingly apparent that, for this purpose, an optical density of ND 5.1 or even one of ND 5.57, was not "dark" enough, even on overcast days. On "bright" days, the scene was that of an unrealistically bright moonlight night. Accordingly, a further study of the light qualities which are involved was conducted to select an optimal density or range of densities which might give more operationally usable results (for details see Annex F).

Pilots, instructors and commanders found the goggles to be acceptable from a comfort and ease-of-use standpoint. They recommended that experimentation continue and expressed opinions that use of the device might well provide an effective, simple, safe means for attaining, maintaining, and perhaps for evaluating night terrain flight skills. No apparent shortcomings were uncovered, although a problem with "fogging" was identified and noted as an area requiring more experimentation.

Among the several apparent strengths of the use of the device is the fact that it reinforces some principles of night flight which are easily forgotten (e.g., the aviator must fly *lower,* to be able to see terrain features by which to navigate, and *slower;* if the aviator does so, he *can* fly in the terrain). Apparently, there is an almost unduplicated training opportunity to be found in the fact that the "night" scene presented has no cultural lighting. Aviators navigate at night primarily through relating their position to cities, highways, airports, etc., which are identified, not by their form or by their location in the terrain, but *by their lights*. In contrast to combat areas where there is little, if any, cultural lighting. Yet, the aviator still must be able to discern the location of the aircraft and to navigate to a given destination. There are very few training environments available to Army aviation commanders which provide unlighted areas in which aviators can acquire and practice these skills. The device accompanied by some means to illuminate maps and essential aircraft instruments, would change any daylight training area into one in which these navigation skills can be practiced.

One-piece, polycarbonate lenses, cut to fit the standard goggles such that they will eliminate some problems of light leakage have been ordered from Omnitech, the maker of the earlier lenses. When the standard goggles and fitted lenses have been delivered, a new phase of testing can begin. This testing will involve various Army aviation organizations operating in diverse training environments.

The filters which have been selected for this testing are ND 6.0 and ND 7.0. These would seem to provide for the simulation of night scenes of a "usable" darkness during ambient daylight conditions which vary from a bright, clear, high-overhead-sun day to one which is dull and overcast. Use of the ND 6.0 lens on a bright day will provide a bright moonlight scene, which may be a useful starting point for night

terrain flight training, even though such a "night" may represent the "ideal" conditions which, unfortunately, are not often present. Use of the ND 7.0 filter on dull, overcast days may offer too few visual cues and may approach the condition under which, in actual combat, some form of battlefield illumination would be needed for the flight operation to continue. One approach to simulate that illumination is being provided would require changing the lens used from ND 7.0 to ND 6.0 and then resuming the operation.

The above investigation has indicated that these devices offer great potential for being able to meet the basic requirement for training in night flight operations. When field testing on these devices has been completed, and if their utility has been established, then, detailed procedures for use of the devices, based upon the results of the testing, would be prepared for the night training module.

ANNEX F

SELECTION OF FILTER DENSITY FOR NIGHT SIMULATION GOGGLES

ANNEX F

SELECTION OF FILTER DENSITY FOR NIGHT SIMULATION GOGGLES

The only visually important difference between night and day is that there is less light at night. The spectrum of night light (amount of energy per wavelength) also differs slightly from daylight. But this difference is visually unimportant because the eye is insensitive to color on even the brightest moonlit night. During night, everything appears either black, white or grey.

To simulate nighttime during the day, it is only necessary to reduce daylight reaching the eyes by the right amount. This is easily done using goggles with a neutral filter.

The choice of density of the filter depends only on the level of night illumination that is to be simulated and the prevailing level of day illumination. Because daylight and nightlight levels vary, however, it is necessary to consider the ranges of variation to determine if a single filter can be used or whether additional filters with different densities must be available for different day illumination conditions or to simulate different levels of night illumination.

There is no operationally defined criterion for how much illumination is necessary for visual night flight. The generally accepted minimum is based on whether or not the horizon is visible. Factors other than the ambient night illumination, however, affect the visibility of the horizon. The presence or absence of cultural lighting in the operational area, cloud cover, and other meteorological obscurations, affect horizon visibility.

Night illumination is primarily dependent on moonlight. It is generally acknowledged that on a clear night with a full moon high overhead, high and low level visual flight is not much more difficult than during the day. As night illumination decreases due to reduction in the phase of the moon (the proportion of the disc of the moon that appears to be lighted), the height of the moon in the sky, and the presence of cloud cover, night visual flight becomes more difficult.

The absence of definite criteria for adequate and inadequate illumination levels for night visual flight does not mean appropriate night illumination levels necessary for training cannot be selected; it only means that there are no obvious choices. Instead, the selection of the night illumination levels to be simulated must be made on the basis of a practical analysis of the range of naturally occurring night illumination levels, their frequency and their visual consequences.

ILLUMINATION - DAY AND NIGHT

The first consideration in the analysis of day and night light levels is the form of measurement. Illuminance, the amount of light falling on an object, is the appropriate measure for the present analysis. The only alternative measure is luminance, the light coming from an object. Luminance is the product of object reflectance and illuminance. Reflectance will vary from object to object but remains constant during both day and night. It would unnecessarily complicate the analysis to consider the reflectance of all naturally occurring objects when their luminance will all be affected in the same proportion by the prevailing illuminance. Illuminance is therefore the simpler and more appropriate measure for the present purpose. Luminance need only be considered when a question about a specific object's visibility arises.

The range of illuminance from the brightest day to the darkest night is enormous. The illuminance of an object on the darkest night is one billion times less than on the brightest day. Because of this extreme range, it is convenient to express illuminance values in common logarithmic units, i.e., powers of 10. An illuminance of 10 foot-Candles (ft-C) is 10^1 ft-C, 100 ft-C is 10^2 ft-C, .01 ft-C is 10^{-2} ft-C, etc.

There are two additional reasons for expressing illumination in logarithmic units. First, the visual impression of light is proportional to logarithmic changes in illumination. For an object to appear twice as bright, the illuminance of the object must be increased ten times. Second, the strength of filters is expressed in terms of the logarithm of density rather than the amount of light transmitted. A neutral density (ND) filter which passes 1% (.01) of the light striking it is referred to as a ND 2 filter. Transmittance equals the reciprocal of 10 raised to the density value (D), i.e., $T = 1/10^D$, so T of 1% (.01) = $1/10^2$. All further discussion of day and night illumination levels will be in common logarithmic terms.

Figure F-1 and Table F-1 show day and night levels of illumination for various conditions. The information in the table and the figure are the same. Several features of Figure F-1 should be noted:

1. Day illumination is primarily dependent on the height of the sun and cloud cover.

2. Night illumination is primarily dependent on proportion of the apparent disc of the moon (phase of the moon), height and cloud cover.

3. Both day and night illumination change at the same rate as a function of the height of the sun or moon in the sky.

4. The change of illumination from sun or moon overhead 90° to sun or moon within 26° of the horizon is only .5 log unit.

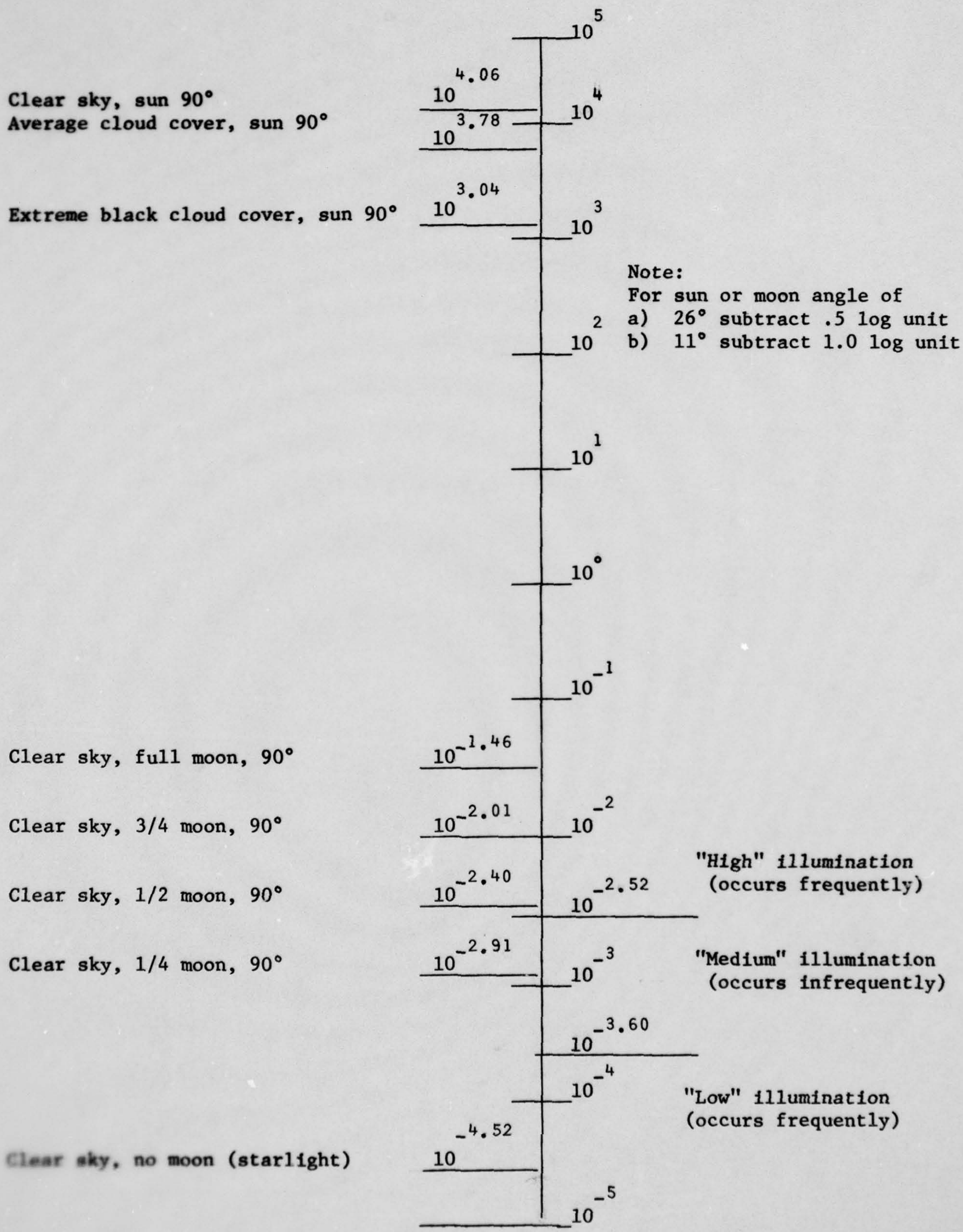

Figure F-1. Day and Night Illuminance ($\log_{10}$ foot-Candles).

Table F-1

Day and Night Illuminance Foot-Candles ($\log_{10}$ ft-C)

Condition	Sun Altitude					
Sun	90°		26°		11°	
Clear sky	11,500	(4.06)	3636	(3.56)	1,150	(3.06)
Average cloud cover	6,000	(3.78)	1905	(3.28)	600	(2.78)
Extreme black cloud cover	1,100	(3.04)	347	(2.54)	110	(2.04)
	Moon Altitude					
Moon (clear sky)	90°		26°		11°	
Full	.0345	(-1.46)	.011	(-1.96)	.0035	(-2.46)
3/4	.0097	(-2.01)	.0031	(-2.51)	.001	(-3.01)
1/2	.004	(-2.40)	.0013	(-2.90)	.0004	(-3.40)
1/4	.0012	(-2.91)	.0004	(-3.41)	.0001	(-3.91)

Starlight .00003 (-4.52)

5. The entire range of day illumination, sun directly overhead on a clear day to the sun 11° above the horizon with dark cloud cover, is about 2 log units.

6. The extreme range of night illumination, full moon directly overhead on a clear night to overcast moonless night is about 4 log units. The range of night illumination with some moon is about 2.5 log units.

7. The average difference between sun illumination on a clear day to night illumination with one-half moon on a clear night is about 6 log units.

As noted above, the variation in day illumination and night illumination as a function of sun and moon height in the sky is the same. This means for any night condition simulated by the use of filters that the variation in the simulated night condition due to sun height, i.e., time of day, would be the same as expected in the natural variation of night illumination due to moon height. This is an important point. The purpose of the night simulation is not to hold the illumination condition constant, but to faithfully replicate naturally occurring night illumination conditions. Because day and night illumination change at the same rate, no unusual or artificial night illumination conditions will occur during the simulation.

Because the range of illumination between average daylight and average nightlight with some moon is about 6 log units, it appears appropriate to choose a ND 6 filter to simulate night illumination conditions. Choice of some other filter value either less or more dense, depends on the training value expected from such a choice. Use of a filter 1 log unit less dense, i.e., ND 5, would simulate a full moon high overhead on a clear night condition during average daylight conditions. It is the opinion of Army aviators highly experienced in night visual flight that flying under full moon conditions is relatively easy. It appears, therefore, that simulating this condition would be of minimal value for night training purposes.

On the other hand, if a denser filter were selected, i.e., ND 8, the night condition simulated on an average day would be equal to an extremely dark moonless night. Under these conditions, a horizon is rarely visible unless cultural lighting is present in the vicinity of the training area. Also, under these conditions, almost nothing except the very largest terrain objects, i.e., hills, large nearby trees, would be visibile. Training value would also appear to be minimal under these conditions, since vision would provide very little information for aircraft control or navigation. A very dark night is essentially the equivalent for flight purposes to Instrument Meteorological Conditions.

It appears, therefore, that the original estimate of simulating a partially moonlit night would be of the most training value and therefore for average daylight conditions an ND 6 filter should be used. If the

training day is very bright, i.e., sun overhead in a clear sky, the simulated night condition would approach the full moon condition. On a dark overcast day, the night condition simulated would be equivalent to that of a clear night with less than one-quarter moon low on the horizon.

The unit commander, however, may want some latitude in the night condition simulated for training purposes and not depend entirely on the prevailing sun illumination on the training day. With a ND 6 filter on an average day, approximately half-moon illumination conditions would be simulated. If it were a very dark day, the night illumination conditions simulated would still be equivalent to a night illumination from one-quarter moon or more. Darker daylight illumination conditions would only occur in the presence of severe weather systems which would probably preclude training anyway. Therefore, it is unlikely that a filter less than ND 6 would ever be required.

It may be desirable to simulate night illumination conditions of less than half a moon on bright, clear days. To achieve a minimum moonlight condition on a bright day would require a filter value of approximately ND 7. On a bright, clear day, an ND 7 filter would produce night illumination conditions equivalent to one-quarter moon on a clear day. If the daylight illumination is average or less, a much darker night condition, but still greater than a moonless night condition, would be simulated. It is concluded, therefore, that the useful range of simulated night illumination conditions for visual flight training during the day can be achieved by the selective use of either an ND 6 or an ND 7 filter.

An additional consideration supports the recommendation to have both a ND 6 and ND 7 filter available for night simulation. The level of night illumination is not evenly distributed in time over the period of a lunar month[F-1]. Luminance levels above 10-2.52 ft-C occurs over most of the night hours for approximately half the month. Illuminance levels below 10-3.6 ft-C occurs during most of the remaining night hours of the month. Luminance values over the approximately 1 log unit range between these two values occurs for only a relatively few number of hours on a few number of days. Both operational and training night flying will therefore usually occur during either relatively high or low night illuminance conditons. Realistic simulation of these high and low night illuminance conditions can be achieved by the use of the ND 6 and ND 7 filters. Depending on the prevailing day illuminance, the commander has available the choice of conducting simulated night training during the two night illuminance conditions that will be most frequently encountered during actual night visual flight operations.

[F-1] Holman, G. L. How High the Moon--How Bright the Night. *US Army Aviation Digest, 22(9)*, September 1976.